Scientists in Flanders their reactions of what researchers can use the infrastructure for

Professor Pieter Libin (VUB):
"Recent developments in AI are rooted in theoretical foundations and the availability of large amounts of computing power," says Professor Pieter Libin of the VUB Artificial Intelligence Lab. "To compete at the top level of AI research, it's essential to have access to a supercomputer such as Tier-1, and especially a supercomputer with several GPUs. GPUs are computing units that are very similar to the graphics card on which your son or daughter plays computer games, but much more powerful. These systems enable significant efficiency gains in training and evaluating new complex machine learning models. In addition, at the AI Lab, we have a rich tradition of using agent-based models to study the emergence of language, aspects of computational creativity and, for example, the mitigation of infectious diseases in a simulated environment. The agent suggests a basic concept, such as an individual in a social network, when modelling infectious diseases within a population. These simulations typically consider a large number of agents, which makes it very challenging, computationally. Here, too, the supercomputer offers opportunities to carry out experiments more quickly and extensively."

Professor Frank De Proft (VUB):
"The demand for new chemical compounds and materials with suitable properties increases every year," says Professor Frank De Proft of the VUB research group Algemene Chemie, which has been carrying out research in computational chemistry since the 1980s. "The computational power of the Tier-1 allows us to simulate complex materials and chemical reactions and to predict the properties and reactivity of compounds based on atomic-scale modelling. Computing power is of huge strategic importance for the technological developments that come from this."

Professor Tinne Tuytelaars (KU Leuven):
"The Tier-1 proved crucial for our earlier research into computer vision, as it enabled us to train larger models on larger amounts of data, allowing us to present state-of-the-art results. We want to further expand our research from still images to video data and multimodal data, and preferably full videos rather than short clips. For that, we will need a lot of computing power," says Professor Tinne Tuytelaars of the research group Stem en Beeldverwerking at KU Leuven. "As an individual lab, it's impossible to build the necessary infrastructure to compete in a domain that's dominated by the major industrial labs. That makes initiatives like the Tier-1 hugely important. Without national and international initiatives such as this, we would have to leave research in certain critical areas, such as AI, entirely up to companies – which is clearly not the ideal situation."

Professor Wim Thiery (VUB):
"We work with the Community Earth System climate model, in which we combine data from all elements that determine the climate – the oceans, ice caps and glaciers, the atmosphere, and the land. To calculate our models, we could not do without the power of a supercomputer. Only then can we make realistic predictions about the consequences of global warming," says climatologist Wim Thiery.

Professor Jef Vandemeulebroucke (VUB):
“My research revolves around medical image analysis for image-guided therapies, computer-assisted diagnosis and clinical decision support for precision medicine,” says Professor Jef Vandemeulebroucke, who works on multidimensional signal processing and communication at VUB. “The computing power and fast data storage of the Tier-1 allows us to create larger, more accurate AI models to distinguish pathologies from normal anatomy on different types of medical images. That computing power also allows us to predict which treatment is most likely to succeed, by studying a large population of previously treated patients and defining the relationships between patient characteristics, the care administered and patient progress. We hope to eventually be able to always choose the appropriate treatment for each patient.”

Professor Hans De Winter (UAntwerp):
“Without the Tier-1 infrastructure of the Flemish Supercomputer Center, our research into the mechanisms of drugs would be completely impossible. For us, this infrastructure is both our laboratory and our research equipment,” says Professor Hans De Winter of the Medical Chemistry research group at UAntwerp. “We use these powerful systems every day to simulate and understand, on an atomic scale, the binding of drugs to their pharmacological protein. For example, during the Covid epidemic, we fully deployed the Tier-1 system in the search for potential SARS-CoV-2 inhibitors, and today we’re using it in the development of targeted cancer therapies and diagnostics.”

Professor Rony Keppens (KU Leuven):
“The Tier-1 supercomputer plays a crucial role in contemporary solar physics research, where numerical simulations can give us extremely sharp images of, for example, sunspots, solar flares and solar filaments,” says Professor Rony Keppens of the Centre for Mathematical Plasma-Astrophysics at KU Leuven. “The sharpness of those images exceeds the resolutions achieved with state-of-the-art solar telescopes. We have discovered, for example, that there is such a thing as solar rain, in which condensation occurs in the solar atmosphere, which then falls to the solar surface along oblique, curved paths. Those paths show us how the sun’s magnetic field manifests itself in loops.”

Professor Veronique Hoste (UGent):
“Large language models have become ubiquitous in recent years and have led to dramatic performance improvements in a wide range of natural language processing tasks, in terms of both automatic language comprehension building and automatic language generation,” says Professor Veronique Hoste of the Language and Translation Technology research group at UGent. “Those models are often heavily focused on English, even if they are multilingual, and are often trained on data whose provenance is not clear and not always available. Thanks to the Tier-1 infrastructure, we can develop our own large-scale, open-source language models for the Flemish research community, with a focus on the Dutch language.”

Professor Danny Vanpoucke (UHasselt):
“Developing new materials and improving existing ones requires a deep understanding of what is happening at the atomic scale. That ranges from new battery materials and the circular use of biopolymers such as lignin, to developing new quantum qubits in diamond for

the current quantum revolution," says Professor Danny Vanpoucke of the Institute for Material Research (IMO) at UHasselt. "However, that information is only accessible from theoretical models founded in quantum mechanics and quantum chemistry. The accuracy of those quantum mechanical models goes hand in hand with their complexity and the associated computational cost. The computing power available to us through the Flemish Tier-1 facility allows us to make rapid progress, support our colleagues in experimental research and help them to rationally design new materials. If we want to be at the forefront of innovative materials research in Flanders, then access to the Flemish Tier-1 supercomputer is vital. It allows us to study more realistic models, increasing the predictive value of our computational materials research."