When students solve global challenges with supercomputers: the Arnes Hackathon 2025

This year's Arnes Hackathon 2025 has once again shown that open science and supercomputing are key tools to tackle the challenges of modern society. Under the slogan “Fly into the future with open science and supercomputing”, more than a hundred participants from all over Slovenia took part in finding innovative solutions to the challenges set by the HackathON. The Hackathon took place in two rounds with a clear focus on sustainable development, the use of digital twins, and HPC technologies.

First round: creative start and idea generation

The first round of the HackathON took place on the 12th of March 2025 at the Faculty of Computer and Information Science, University of Ljubljana. 29 teams registered to participate, bringing the total number of competitors to over 100 students. The participants were acquainted with this year’s themes, which included a challenge on health and well-being, a space challenge, along with the possibility of creating an individualized challenge with a focus on using digital twins. The space challenge was especially highlighted, as Slovenia became a full member of the European Space Agency (ESA) this year.

Before the first round, Arnes, in collaboration with the National Competence Centre for supercomputing organized a lecture on the basics of supercomputing by dr. Ratko Pilipović, Assistant Professor at the Faculty of Computer and Information Science UL, and dr. Davor Sluga, Assistant at the same faculty. This was important, as the teams in the first round had access to Arnes’ supercomputing cluster for data processing. To provide a deeper understanding of the inner workings and the use of digital twins, Arnes also organized a lecture by dr. Slavko Žitnik, Associate Professor at the Faculty of Computer and information Science UL, and the president of the Slovenian Society INFORMATIKA.

Arnes HackathON differs from traditional 24-hour format in that it allows teams to fully develop their ideas over several weeks between the two rounds, allowing for in-depth wok and the use of more complex technologies such as supercomputing.

Second round: applying HPC and AI in praxis

The eight best teams qualified for the second round, which took place on the 15th of April 025 during the Slovenian Informatics Days conference in Portorož. Their solutions were based on the use of open research data, access to supercomputing infrastructure, machine learning and digital twins.

Since the teams in the second round were given access to the EuroHPC Vega supercomputer at IZUM, a lecture on HPC containers was organized as part of the HackathON, also given by dr. Ratko Pilipović and dr. Davor Sluga. To help the students use advanced technologies as efficiently as possible, they had the opportunity to attend two more lectures on big data processing in Python, given by dr. Mladen Borovič, Assistant at the Faculty of Electrical Engineering and Computer Science, University of Maribor.

To complete the competition, the teams presented their solutions to a panel of experts and a general audience. The event was broadcast live via the Arnes Video portal, and online voting for the audience was made possible via Arnes 1KA.

Winners: optimizing the production of biological medicines

The winning team, Ekipa42, presented a solution to optimize the production of biological medicines using digital twins. Their innovation combines the field of biotechnology with high-performance computing and thus offers new methods to improve the efficiency of production processes. They plan to use artificial neural

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networks to adjust parameters in the bioreactors in real-time, allowing simulations of cell lines and optimized development of biological drugs.

The second place went to the team 5 prijateljev, who tackled the challenge of containing the spread of forest fires. Using semantic segmentation of satellite data processed by a supercomputer, they presented a system for early detection of fire-prone areas. This would allow them to respond to fires more strategically, placing barriers at the most vulnerable locations, thereby limiting their spread quicker.

The third place, as well as the people's choice winner, went to the DPR team, which developed a solution for monitoring deforestation using satellite imagery that would be reviewed by AI on an ongoing basis.

The teams used supercomputing infrastructure mainly to process large amounts of data and to run simulations of their proposed innovations. Jani Pogačar from the Faculty of Information Studies at the University of Nova Gorica, offered them expert assistance in the use of HPC. Dr. Samo Stanič, professor at the School of Science at the University of Nova Gorica and the coordinator of the Slovenian National Supercomputing Network SLING, was in charge of evaluating the solutions from a supercomputing stance in the expert jury.

HPC as key part of the innovation process

The shortlisted teams showed that supercomputing can be used to solve complex social, scientific and environmental challenged, as the use of HPC technology enables deeper insights and more effective solutions. It was not only the winning teams who used HPC – seven of the eight top teams envisaged using it in their solutions.

In addition to the mentors from the fields of academia and research, the competitors were also helped by experts in the fields of open science, public administration, space, informatics and the industry. In addition, the Slovenian Supercomputing Network (SLING) consortium also played a special role in the content support by providing access to the relevant infrastructure and mentors.

The organization of HackathON was made possible by Arnes, the Slovenian Society INFORMATIKA, the Ministry of Digital Transformation, the Ministry of Public Administration and the Faculty of Computer and Information Science of UL, in cooperation with a number of partners, including the National Competence Centre SLING. The event was held under the honorary patronage of the Slovenian National Commission for UNESCO.

Building an open future together

HackathON 2025 highlighted the well-known fact that bringing together students, researchers, experts and institutions can create an environment where significant innovations using supercomputing are not just a vision, but a reality.

To learn more about the teams' solutions, videos of the presentations and the background to the event, visit the HackathON website and the Arnes Video portal.

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