



Use of supercomputers for drone data processing and analysis

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Non-profit state
organization with
special tasks



Turn over in 2023

73,6 M€



LUMI

Owned together with EuroHPC JU
and unique consortium of
10 countries – Belgium, Czech
Republic, Denmark, Estonia,
Finland, Iceland, Norway, Poland,
Sweden and Switzerland.



Headquarters
in Espoo,
data center
in Kajaani



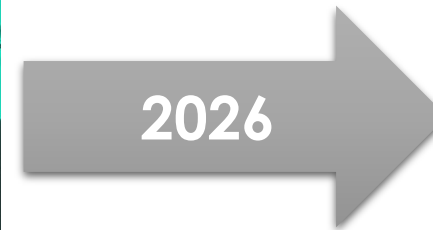
Owned by the Finnish state **(70%)**
and all Finnish higher
education institutions **(30%)**

Use of supercomputers for drone data processing and analysis



711
(09.2025)

CSC supercomputers



The Queen of North **LUMI**

European flagship
supercomputer



www.lumi-supercomputer.eu

#lumisupercomputer

#lumieurohpc



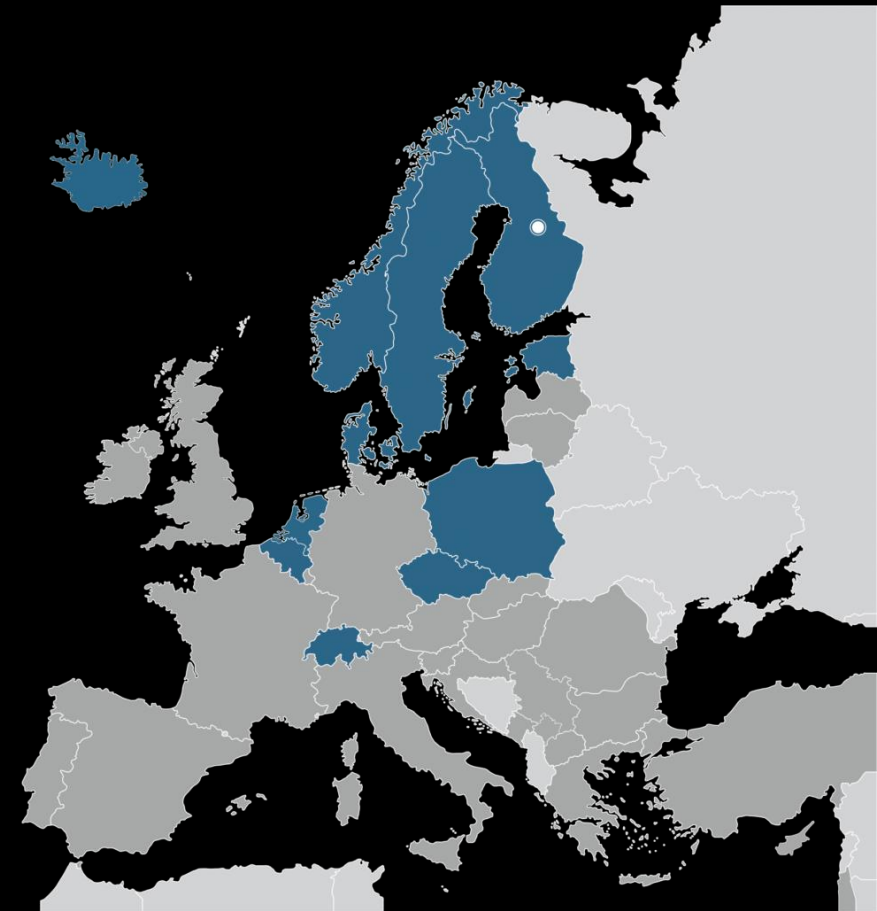
EuroHPC
Joint Undertaking



EuroHPC Joint Undertaking: Europe's world-class scientific computing and data management research infrastructure (high-performance computing, HPC)

EuroHPC funding: EU and participating countries

- **The supercomputer hosted by the LUMI consortium (11 countries) in Kajaani**
- Developing competence in high-performance computing
- **Private companies can also access**
- Over 2600 scientific projects have been running on LUMI, and over half of LUMI's computing resources have been utilized for AI-related research and innovation.



- OpenStack based cloud.
- Serving cloud computing needs of Finnish research institutes & universities since 2013.
- VMs and Control plane can be accessed via public internet.
- Customers may decide access to VMs by creating firewall rules at OpenStack level known as "Security Groups".
- ISO27001 certified.
- Can support modern DevOps, Agile, CI/CD etc. environments.
- Could be used for hosting:
 - Scientific applications,
 - Custom services such as Web servers, File servers, load balancer etc.,
 - Virtual Computer class,
 - Research Data Sharing etc.

Why Pouta?

- Pouta is very affordable.
- Data stays in Finland
- We have comprehensive customer service

LUMI AI Factory



EuroHPC
Joint Undertaking



EUROPEAN UNION
European Structural and Investment Fund



LUMI AI Factory



- The three pillars of LUMI AI Factory
 - AI-optimised supercomputer **LUMI-AI**
 - AI Factory **Service Center**
 - Experimental quantum-computing platform **LUMI-IQ**
- CSC (Finland) coordinates consortium with participation from Czechia, Denmark, Estonia, Norway and Poland
 - Other Finnish partners are FCAI (Aalto University, University of Helsinki) and AI Finland (Technology industries)
- Total budget over 612 million euros
 - EU 306.4 M€, FI 250 M€, CZ 11 M€, DK 10 M€, EE 5 M€, NO 20.4 M€, PL 10 M€
 - largest public computing ecosystem investment in Finland, among the largest in Europe
 - largest EuroHPC AI Factory investment
- Significant investment in talent and competence development

Supercomputers usage

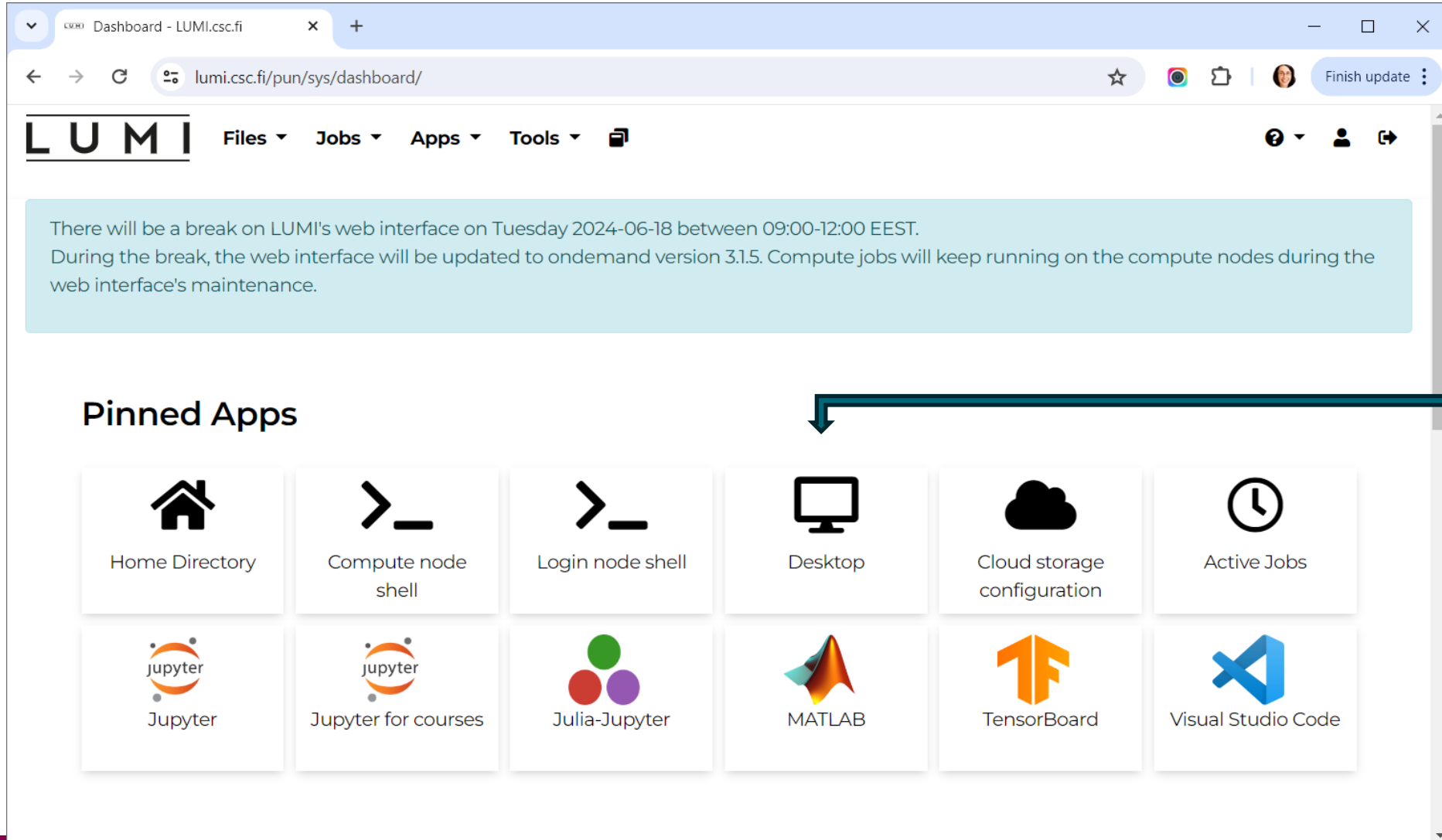
- **GeoAI**
 - **Training Deep Learning models is 10-100x faster with GPU than CPU**
 - **... and even faster on multi-GPU**
- Big data analysis
- Advanced modelling
- Not for:
 - Web services
 - Time-critical/real-time applications
 - Sensitive data (yet)



Working with supercomputers

- Main work is done via **scripts**
- **Graphical tools** available for:
 - Code development (Visual Studio Code, Jupyter)
 - Input or output review (QGIS)
- Scripts are sent for calculation as **batch jobs**, predefining the needed computational resources
- SLURM Workload Manager schedules the jobs
- Important to use **parallel computing**

Graphical web interface



The screenshot shows the LUMI web interface dashboard in a browser. The browser's address bar displays 'lumi.csc.fi/pun/sys/dashboard/'. The dashboard features a navigation bar with 'Files', 'Jobs', 'Apps', and 'Tools' menus. A light blue announcement banner states: 'There will be a break on LUMI's web interface on Tuesday 2024-06-18 between 09:00-12:00 EEST. During the break, the web interface will be updated to ondemand version 3.1.5. Compute jobs will keep running on the compute nodes during the web interface's maintenance.' Below this, the 'Pinned Apps' section displays a grid of application tiles. A blue arrow points from a callout box on the right to the 'Desktop' tile.

Dashboard - LUMI.csc.fi

lumi.csc.fi/pun/sys/dashboard/

LUMI Files Jobs Apps Tools

There will be a break on LUMI's web interface on Tuesday 2024-06-18 between 09:00-12:00 EEST. During the break, the web interface will be updated to ondemand version 3.1.5. Compute jobs will keep running on the compute nodes during the web interface's maintenance.

Pinned Apps

 Home Directory	 Compute node shell	 Login node shell	 Desktop	 Cloud storage configuration	 Active Jobs
 Jupyter	 Jupyter for courses	 Julia-Jupyter	 MATLAB	 TensorBoard	 Visual Studio Code

QGIS, GRASS,
SagaGIS

GIS tools suitable for a supercomputer

Python GIS packages

R GIS packages

ArcGIS Python API (not arcpy)

SNAP, sen2cor, sen2mosaic

CloudCompare

FORCE

LasTools

OpenDroneMap

Orfeo Toolbox

PCL

WhiteboxTools

Open source
tools available
for **Linux**

Running on:
CPU or
GPU

GIS tools NOT suitable for supercomputers



Windows only tools

ArcGIS, TerraScan

APIs

GeoServer, MapServer

Databases

PostGIS, MongoDB

Web-map front-end

OpenLayers, Leaflet

Pre-installed tools in LUMI:

- Deep learning:
 - **PyTorch**
 - Keras/TensorFlow
- GIS:
 - QGIS
 - GRASS-GIS
 - SagaGIS
 - GDAL
 - PDAL
 - **Geoconda** – Python package for spatial data analysis
- <https://docs.lumi-supercomputer.eu/software/>
- <https://docs.lumi-supercomputer.eu/software/local/csc/>

Pre-installed tools In Puhti:



All tools from LUMI + R GIS packages

ArcGIS Python API (not arcpy)

CloudCompare

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LasTools

OpenDroneMap

Orfeo Toolbox

PCL

SNAP, sen2cor, sen2mosaic

WhiteboxTools

- https://docs.csc.fi/apps/by_discipline/#geosciences

Own installations

Tools for installation:

LUMI container wrapper /Tykky

Conda, pip or Docker based installations

Apptainer containers

EasyBuild

SPACK

Add Python packages to existing installations

<https://docs.lumi-supercomputer.eu/software/installing/python/>

Drone image processing environment at CSC - what's coming

- In Research Council of Finland project **Geoportti** 2025 – 2029: Aim to build a pilot service for drone data storage and sharing by University of Eastern Finland
- LUMI AI Factory
 - Comprehensive plan for Dataset-as-a-Service
- DL26 (national supercomputers) programme: Allas, Roihu
- Secure processing environment

Drone related links

- Gbagir, A.-M.G.; Ek, K.; Colpaert, A. **OpenDroneMap: Multi-Platform Performance Analysis**. *Geographies* 2023, 3, 446-458.
<https://doi.org/10.3390/geographies3030023>
- **UEF drone lab page, inc ODM instructions for cPouta:**
<https://www.geoportti.fi/services/tools/drones/>
- Turkulainen, E. FGI: **Monitoring Bark Beetle Damage: UAS Image Classification with Deep Neural Networks**. 2024.
https://gis-seminars.a3s.fi/2024-02-27/EmmaTurkulainen_FGI.pdf
- **LUKE MetaShape instructions for cPouta:**
https://github.com/csc-training/geocomputing/tree/master/pouta/metashape_with_VNC
- Atherton, J. University of Helsinki: **Optical sensing and 4D modelling of plant ecophysiological traits**. 2022.
 - https://a3s.fi/gis-workshops/2022_point_cloud_workshop/atherton_4d_modeling_odm.pdf

How to get help / Further info

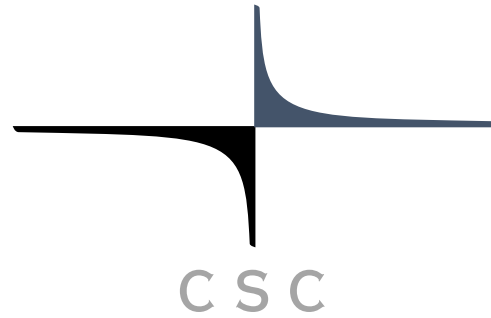
- servicedesk@csc.fi
- CSC User guides and tutorials <https://docs.csc.fi/>
- CSC training: <https://www.csc.fi/en/training#training-calendar>
- CSC LUMI User Support <https://lumi-supercomputer.eu/user-support/need-help/>
- CSC LUMI documentation <https://docs.lumi-supercomputer.eu/>
- LUMI training: <https://www.lumi-supercomputer.eu/events/>
- Geocomputing with supercomputer: <https://research.csc.fi/geocomputing>
- EuroCC-Finland LinkedIn: www.linkedin.com/company/eurocc-finland
- HPC GIS/remote sensing/point cloud use cases: <https://docs.csc.fi/support/training-material/geocomputing-seminars/>

Extra:

- How does accessing a supercomputer look like? <https://www.youtube.com/watch?v=HB9JUH0mPqI> (k EuroCC Sweden)

Free training and examples

- 8-9.10.2025 Moving your AI training jobs to LUMI: A Hands-On Workshop (Stockholm / online)
<https://www.lumi-supercomputer.eu/events/moving-your-ai-training-jobs-to-lumi-a-hands-on-workshop/>
- **8.-9.10.2025 Geocomputing course (Espoo / online)**
<https://csc.fi/koulutuskalenteri/geocomputing-on-the-supercomputer-2/>
- 20.-21.10.2025, LUMI Intro Course (Tallinn / online)
<https://www.lumi-supercomputer.eu/events/lumi-intro-course-tallinn/>
- **10-12.12.2025 Practical machine learning with spatial data (Espoo / online)**
<https://csc.fi/koulutuskalenteri/practical-machine-learning-with-spatial-data-2/>
- 24.11.2025 - 25.11.2025 Quantum Machine Learning
<https://csc.fi/en/training-calendar/quantum-machine-learning/>
- Geocomputing examples: <https://github.com/csc-training/geocomputing>
- Previous training materials: <https://research.csc.fi/gis-learning-materials>



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