CENTER OF EXPERTISE IN BIG GEODATA SCIENCE

UNIVERSITY OF TWENTE.

ITC GEOSPATIAL COMPUTING PLATFORM

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Center of Expertise in Big Geodata Science (CRIB) is a *horizontal facility* establish in **March 2020** to **enable** the better use of **big geodata technology** in *education, research, and institutional strengthening* activities at **ITC**

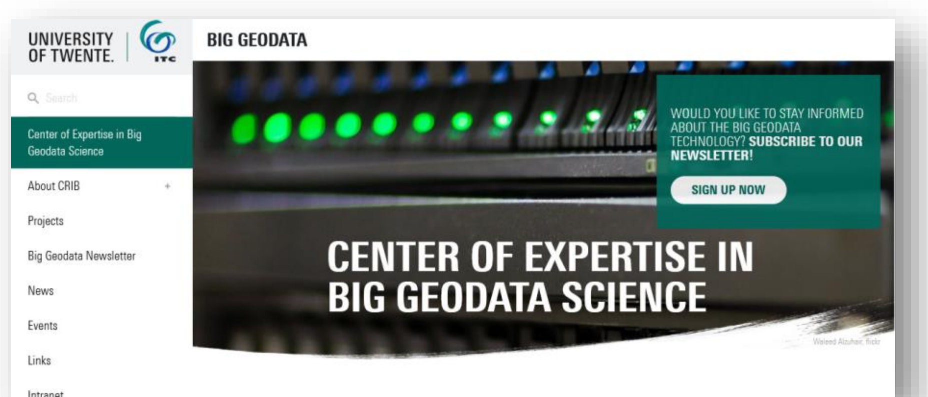
Mission

Collect, develop, and share **operational know-how** on big data technology to solve large-scale geospatial problems

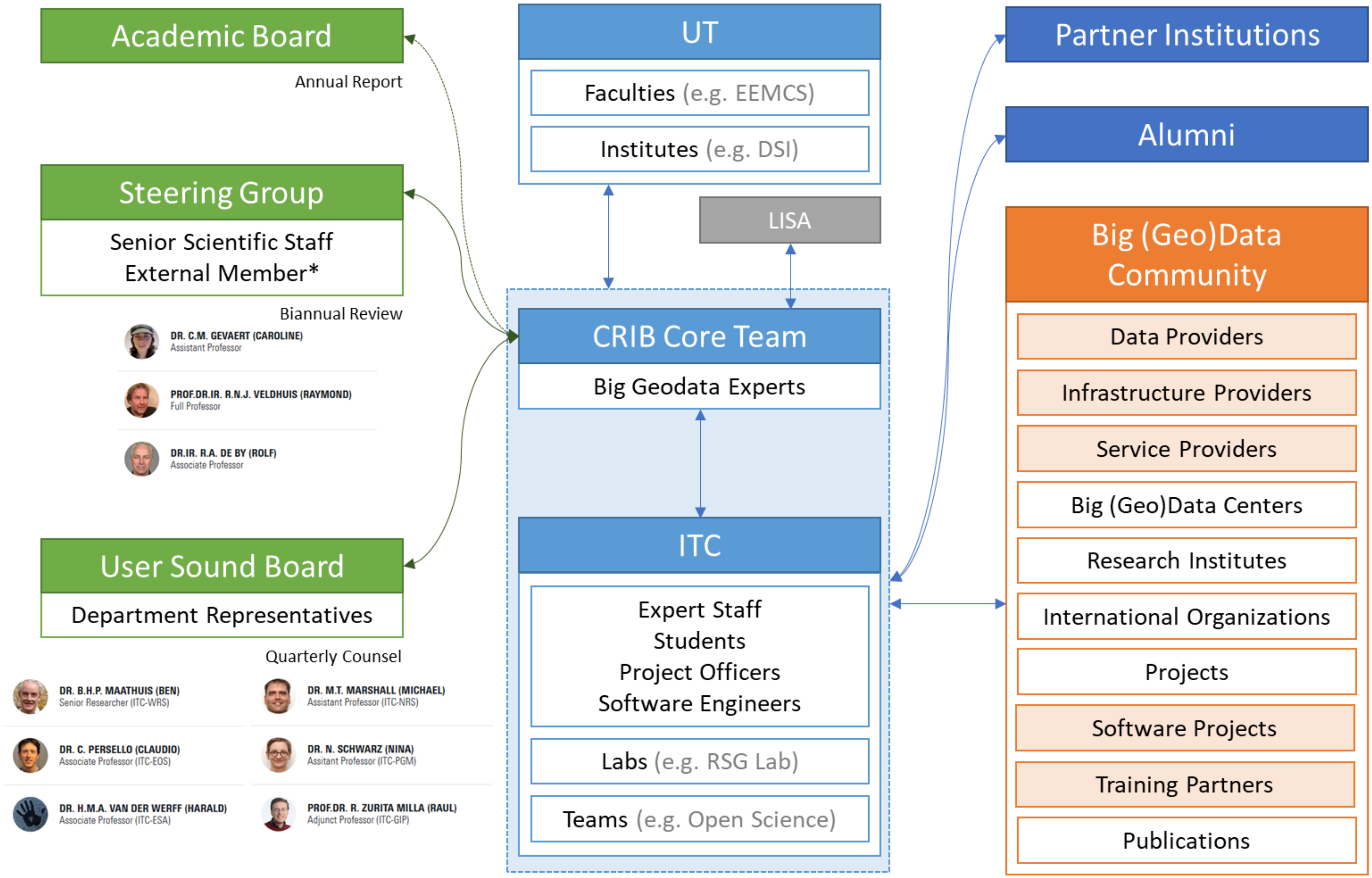
Vision

Position UT/ITC as a *globally renowned* center of excellence in **geospatial big data** science.

https://itc.nl/big-geodata



Structure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UT
Faculties (e.g. EEMCS)
Institutes (e.g. DSI)
LISA
CRIB Core Team
Big Geodata Experts
ITC
Expert Staff
Students
Project Officers
Software Engineers
Labs (e.g. RSG Lab)
Teams (e.g. Open Science)
Partner Institutions
Alumni
Big (Geo)Data Community
Data Providers
Infrastructure Providers
Service Providers
Big (Geo)Data Centers
Research Institutes
International Organizations
Projects
Software Projects
Training Partners
Publications

Activities

- Capacity and Knowledge Development
  - Improving expert knowledge, providing theoretical and hands-on training, facilitating community
- Infrastructure Development
  - Local and cloud-based infrastructure for big geodata computing
- Project Services
  - Consultancy and advisory services for integration and better use of big data technology, active support to research projects
- Monitoring and Networking
  - Monitoring recent developments in big (geo)data technology, networking with data providers, developers, research institutions
- Visibility
  - Ensuring high visibility of big-data related activities

Big Data Needs Assessment

- Key Findings
  - **Information** on big data technology should be actively communicated to the staff and students
  - **Proficiency** of the staff and students should be improved
  - Easy-to-use **computing infrastructure** should be made available
  - **Research projects** should be enhanced and improved with big data technology
  - Big geospatial data know-how should be transferred to **alumni and partners**

Modern **computing infrastructure** is necessary not only for big geospatial data analysis, but also for **geospatial data analysis** in general.

ITC Geospatial Computing Platform

- Designed to serve primary activities identified by the needs assessment:
  - **Self-learning**
  - **Exploratory research**
  - **Education**
- Provides **highly-available, easy-to-use** environment with good performance
  - **User-friendly** interface for data analysis and visualization
  - **Ready-to-use** scientific and geospatial analysis software
  - **Parallel and distributed computing** by using high-level frameworks
  - Computing by using special processing units (e.g., **GPU**)

Resources

- **16 x NVIDIA Jetson AGX Xavier** computing units (128 cores, 512 GB)
  - **8-core** CPU (NVIDIA Carmel ARMv8.2, 2.26 GHz)
  - 512-core **GPU** (Volta architecture with 64 Tensor Cores)
  - **32GB** memory (DDR4x, 137 GB/s)
  - 500 GB – 1 TB local storage (NVMe SSD, 3 GB/s)
- **Big data** computing unit
  - 2 x 8-core CPU (Intel Xeon E5-2640, 32 threads, 2.60 GHz)
  - **24 TB** local storage (20 x 1.2 TB 2.5” 10K SAS 12 GB/s HDD, RAID 20+2)
  - **768 GB** memory
- **Hub** server (6-core, 192 GB)
- **200 TB** storage (0.2 PB)

We upgrade and repurpose **idle** resources and make them available on the platform for **common use**.

Architecture

https://crib.utwente.nl

- Based on **open-source** software (Ubuntu, Docker, JupyterHub, …)
- Accessible through a **web browser** (No software installation is required)
- **No registration** is required (Login with UT credentials)
- Each user has an individual and isolated **working environment**
- Each user has access to all available* **unit resources**, including **GPU**
- Each user has access to all available* **cluster resources**
- **Replicated storage** with minimum two copies (Hardware failure protection)
- **Distributed storage** for big data processing (HDFS)
- Low **energy footprint** (10-30W per unit)

Key Features

https://crib.utwente.nl

- **Interactive notebook**, **terminal** and **remote desktop** access are available
- Multiple **interactive languages** are supported (Python, R, Julia, Octave, Go, …)
- **Up-to-date** and **optimized** software packages are **ready to use** (No setup required)
- Users can install **additional** packages (e.g., Python, R packages)
- Distributed computing clusters are **ready to use** (Dask, Apache Spark)
- **Public** assets are shared by all users
- **Shared workspaces** allow assets to be shared by selected users
- Access can be granted to **external users**
- **User support** is available*
- Provided and maintained by **CRIB** at no extra cost (i.e., free PaaS)

Available Software

https://crib.utwente.nl

hadoop · APACHE Spark · DASK · NVIDIA CUDA · OpenCL · OPEN MPI · OpenMP

TensorFlow · Keras · PyTorch · mxnet · scikit learn · SCIKIT-CUDA · XGBoost · RAPIDS

GDAL · PROJ · cartopy · GeoPandas · GeoPy · Iris · PySAL · Coming Soon! R.

NumPy · Numba · pandas · xarray · NetworkX Network Analysis in Python · igraph · ONNX RUNTIME · TensorRT

OpenCV · scikit-image · FFMPEG · Image Magick · GraphicsMagick · matplotlib · FFTW · APACHE ARROW

R Studio · GNU Octave · statsmodels · seaborn · bokeh · HDF5

and hundreds more…

Additional Services

https://crib.utwente.nl

GeoServer
Open source server for sharing geospatial data

MapServer
Open source platform for publishing spatial data

PostgreSQL
Open source relational database

MariaDB
Open source relational database

GeoNode
Open source geospatial content management system

Dataverse
Open source research data repository software

In cooperation with ITC Research Data Team

Incubating! - BETA

Gitea
Open source lightweight code hosting solution

Potential Use Cases

https://crib.utwente.nl

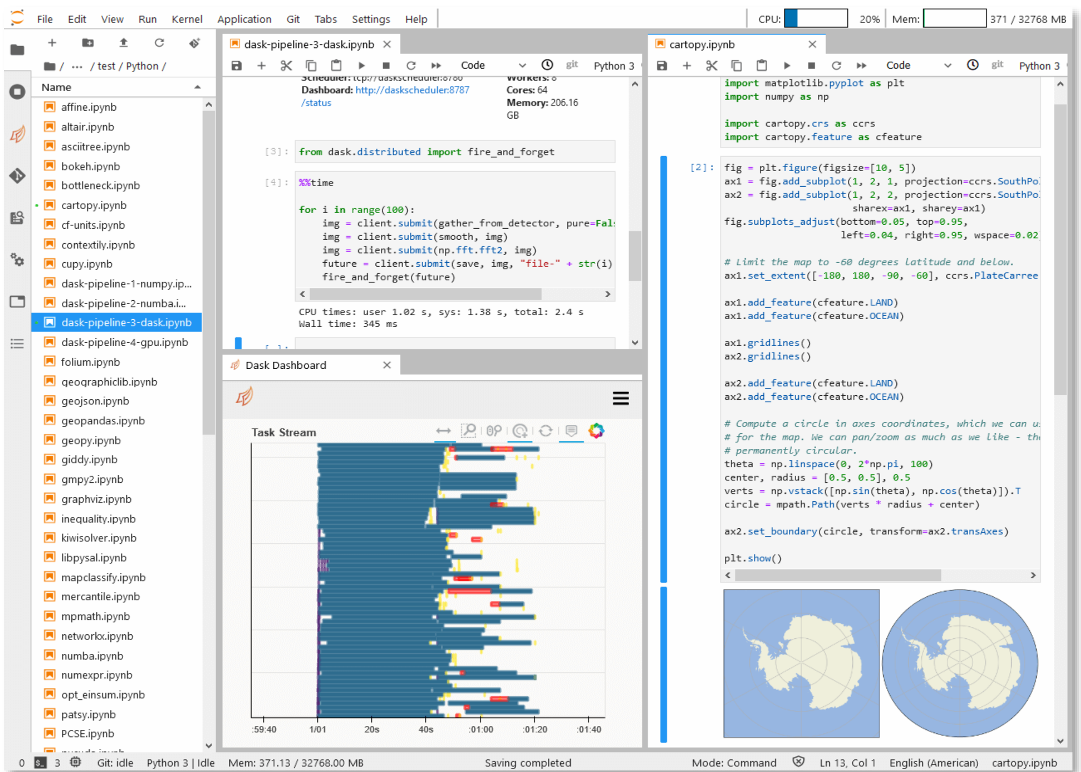
- Education
    - Computation platform for **courses** (Shared course workspaces)
- Research
    - **M.Sc.** / Ph.D. thesis studies
    - Collaborative (big) data analysis and visualization
    - Strengthen **project proposals** (Reduced budget needs for small projects, e.g., 50-100K EUR)
- Capacity Development
    - **Self-learning** (Cloud computing, distributed computing, GPU computing, Machine Learning, …)
    - Computation platform for **training activities** (e.g., workshops)

Current Usage

- Operational since **January 2021**
- **271** registered users
- **5-20** concurrent users at a time
- Provided approximately **15,000** hours of multi-core/GPU computation
- Overall, quite **positive feedback** from a wide-range of use cases
- Several **courses** started to use the platform
- Several **projects** started to use or will use the platform (e.g., IDEAMAPS, EO Africa R&D, TMT+ Bangladesh)
- Several **project proposals** consider to utilize the platform
- Other **UT units** (e.g., DCC, BDSI) are interested in having similar platforms
- **LISA** decided to build a similar platform for UT-wide use

Quick Demo

https://crib.utwente.nl



Available on the platform at **public/platform/demo**

Contact

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crib-itc@utwente.nl

@BigGeodata

Big Geodata Newsletter