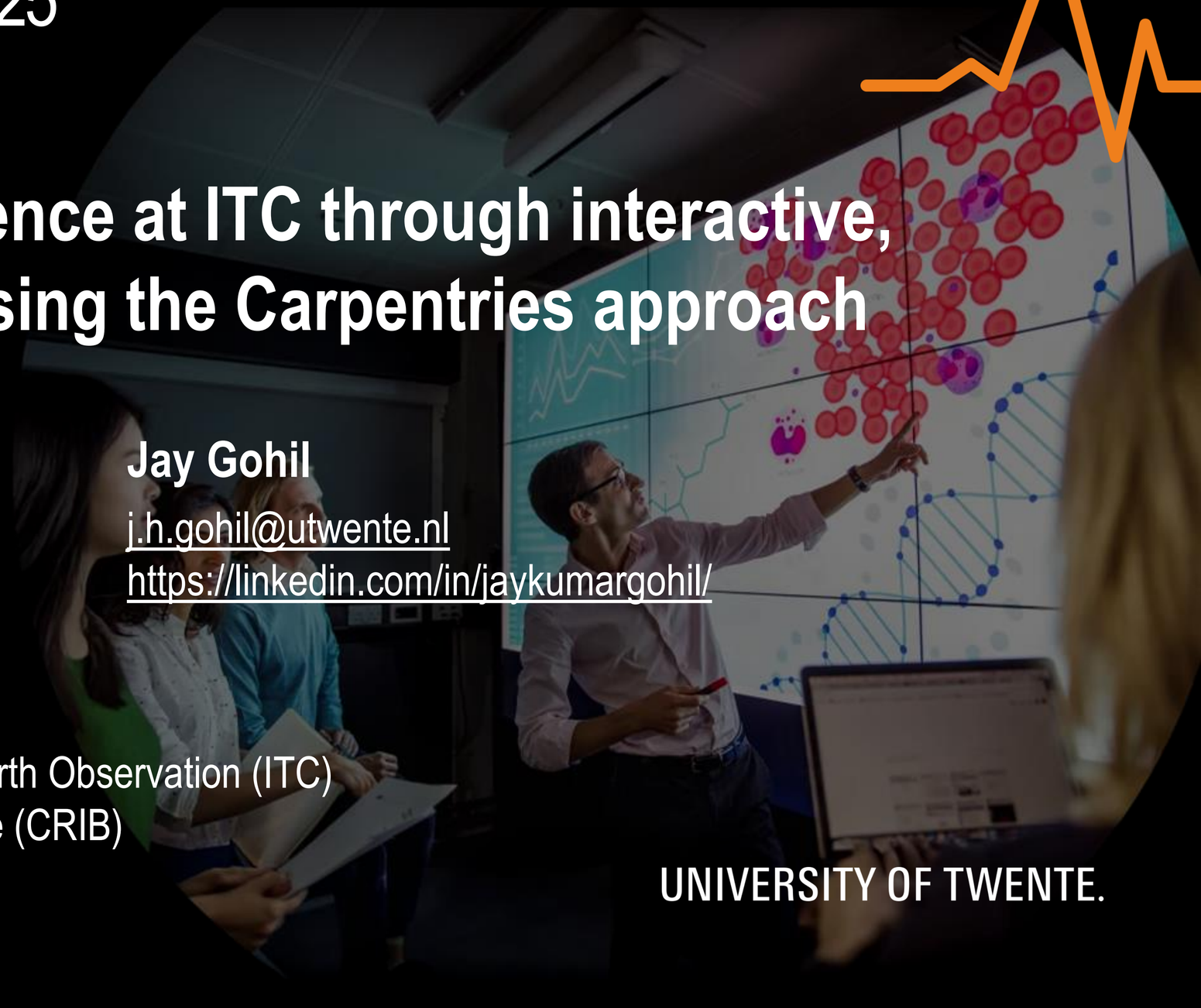
WEEK OF EDUCATION 2025

THE HEARTBEAT OF LEARNING

Teaching (geo)data science at ITC through interactive, hands-on workshops using the Carpentries approach



Dr. Serkan Girgin

s.girgin@utwente.nl
https://linkedin.com/in/serkan-girgin/

Jay Gohil

j.h.gohil@utwente.nl
https://linkedin.com/in/jaykumargohil/

Faculty of Geo-information Science and Earth Observation (ITC)
Centre of Expertise in Big Geodata Science (CRIB)

19 May 2025, Enschede

UNIVERSITY OF TWENTE.

- **Center of Expertise in Big Geodata Science (CRIB)** is a research and expertise center established in 2020 that focuses on the better use of cloud computing and big data technologies in research, education, and institutional strengthening activities related to geo-information science and Earth observation.

- Our mission is to develop, collect, and share operational know-how on these technologies to solve large-scale geospatial problems efficiently.

CRIB

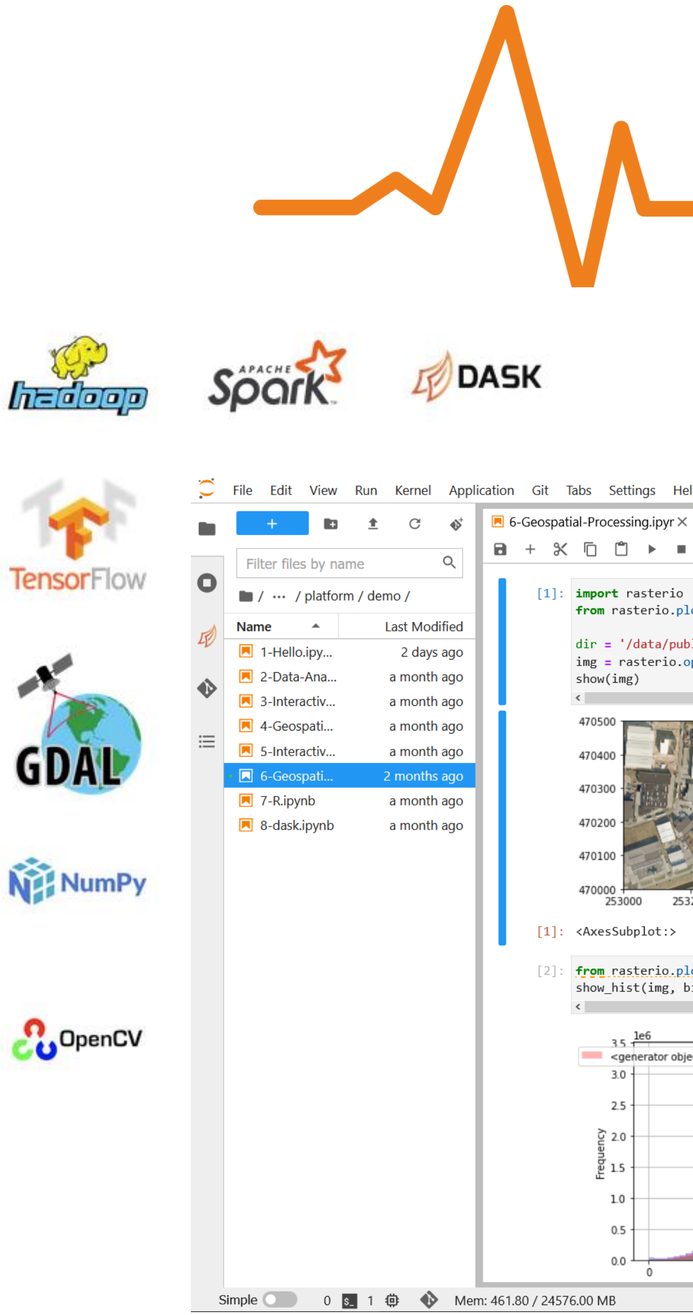
We perform a wide range of research and capacity development projects

- Digital Earth Africa Capacity Development (PI)
- FAO State of Food and Agriculture Phase I and II
- ESA EO Africa R&D Facility Phase I and II
- OKP-NUFFIC TMT+ Bangladesh
- IDEAMAPS Network
- NLeSC - ITC Phenology Alliance (Clustering Geodata Cubes)
- SURF-AWS Phenoregions over Europe & U.S.
- NWO Open Science JupyterFAIR (PI)
- NLeSC GEOnnect (PI)
- TMT IDEAMAP Sudan
- Digital Tools for Geo Citizen Science in Secondary Education (PI)
- SURF DCC Next Generation Research Data Management: Open Data Explorer (PI)
- ESA AlignSAR
- IDEAMAPS Ecosystem
- NWO SmartAvocado: Tracing food flows to connect distant production and consumption
- NLeSC EcoExtreML
- NATO SHAKEN
- NWO Landslide Hunter: a fully automated AI-based platform to map and monitor landslides (PI)
- TDCC NES Sustainable Software
- FAO City-Region Systems Platform (PI)
- NWO OpenSTAC: an open spatiotemporal catalog to make geospatial research data findable and accessible (PI)
- ...

Illustration by storyset.com

We operate a state-of-the-art infrastructure: Geospatial Computing Platform

- Accessible through a web browser, no software installation or VPN are required.
- 1500+ open-source software built from latest source code, optimized for each computing unit.
- Provides access to a wide range of GPU-enabled computing resources and distributed computing clusters
- Available for free to all ITC staff and students*.
- Provided approximately 700,000+ hours of multi-core/GPU computation with 20 x return of investment.



We perform capacity development activities to improve fundamental* know-how to use advanced methods

- Introduction to JupyterLab
- Introduction to Docker
- Geospatial Raster and Vector Data with Python
- Geospatial Raster and Vector Data with R
- Publishing Spatiotemporal Data with STAC
- Publishing Research Data with fairly Toolset
- openEO for Cloud-based Geoprocessing
- Interactive Geospatial Data Analysis at HPC Scales

We build on established best practices by adopting a community-based, globally recognized training model

The Carpentries

Illustration by storyset.com

What is The Carpentries?

- The Carpentries teaches foundational coding and data science skills to researchers worldwide.
- Why these skills? Computational and data-intensive research skills are frequently overlooked in traditional foundational research training across many disciplines.
- Their mission is to empower a diverse global community by equipping individuals with essential data and computational skills.
- Their vision is to be the leading inclusive community teaching data and coding skills.

THE CARPENTRIES

https://carpentries.org

Short history of The Carpentries

- **1998**: Software Carpentry founded by Greg Wilson to help scientists write better code.
- **2014**: Data Carpentry launched, focusing on data skills for researchers.
- **2015**: Library Carpentry joins as a sibling project.
- **2018**: All three projects merge to form The Carpentries.
- **Today**: A global community teaching foundational coding and data science skills through inclusive, hands-on workshops.

software carpentry

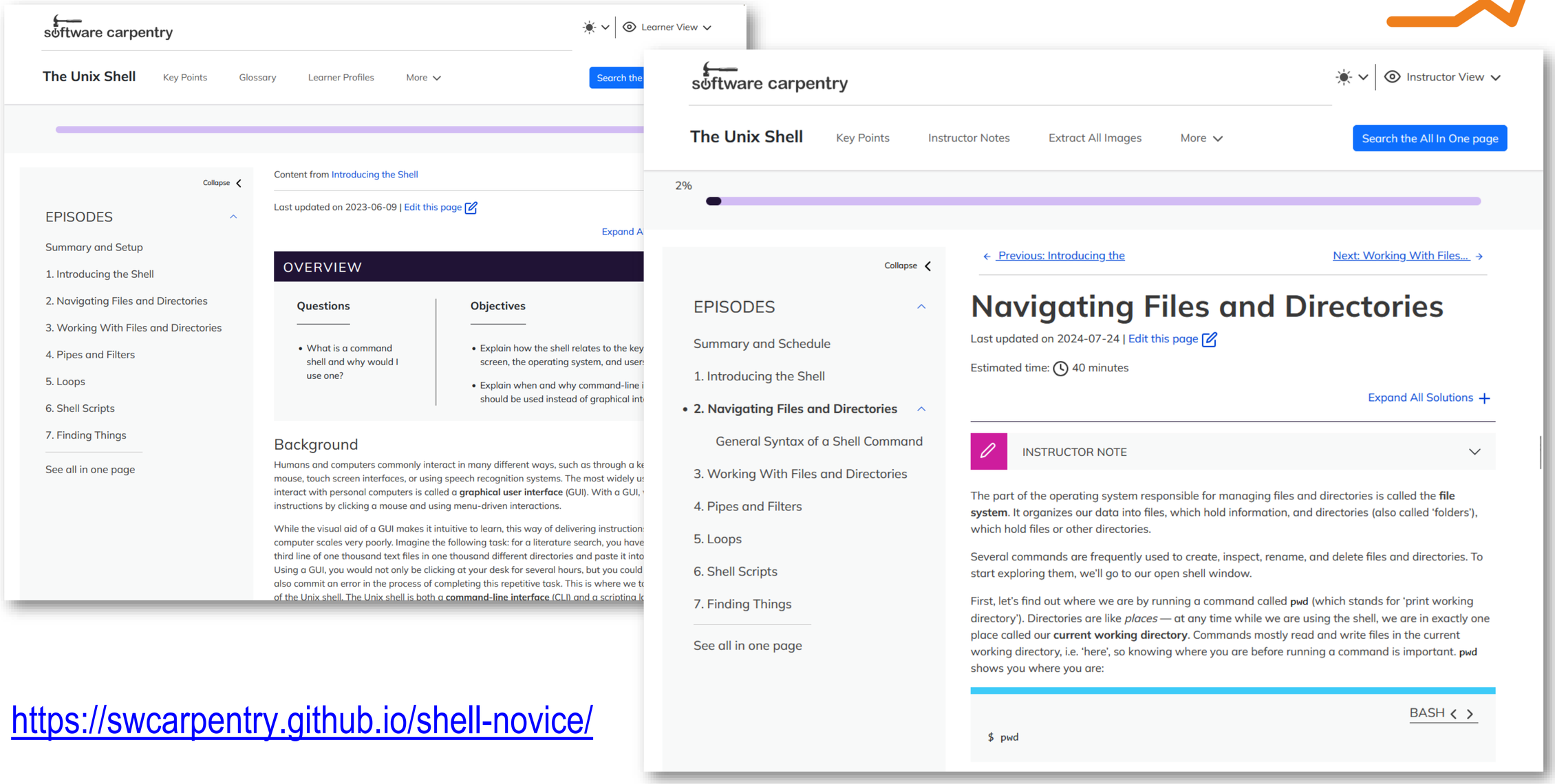
DATA CARPENTRY

library carpentry

List of example courses

- Software Carpentry
  - Python for scientific computing
  - Version Control with Git
  - Unix Shell for file and data management
  - R for reproducible research
- Data Carpentry
  - Data Cleaning and Analysis in Python or R
  - Working with Spreadsheets
  - SQL for Data Queries
  - Domain-specific: Ecology, Genomics, Geospatial
- Library Carpentry
  - Intro to Git and GitHub for librarians
  - Tidy Data principles
  - Shell scripting for librarians
  - Regular Expressions and OpenRefine

An example course from The Carpentries



https://swcarpentry.github.io/shell-novice/

Philosophy of The Carpentries

- The Carpentries believe that everyone can learn coding and data skills, regardless of background.
- Their philosophy is rooted in empowerment, empathy, and community.
- Key Values:
  - Teaching is a skill that can be learned and shared.
  - Learning happens best through doing, not just listening.
  - Mistakes are part of learning and should be openly acknowledged.
  - Equity and inclusion are not add-ons, they are foundational.

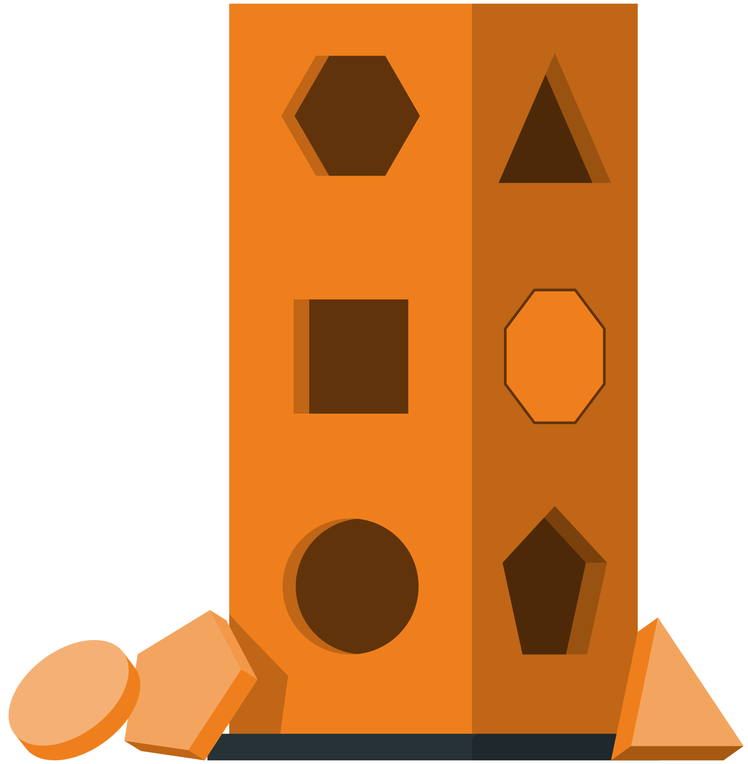


Illustration by storyset.com

The core principles of The Carpentries

- Inclusivity
  Welcoming learners of all backgrounds and skill levels.

- Hands-on Learning
  Practice-driven sessions to build real skills.

- Open Teaching
  All materials are openly developed and freely available.

Illustration by storyset.com

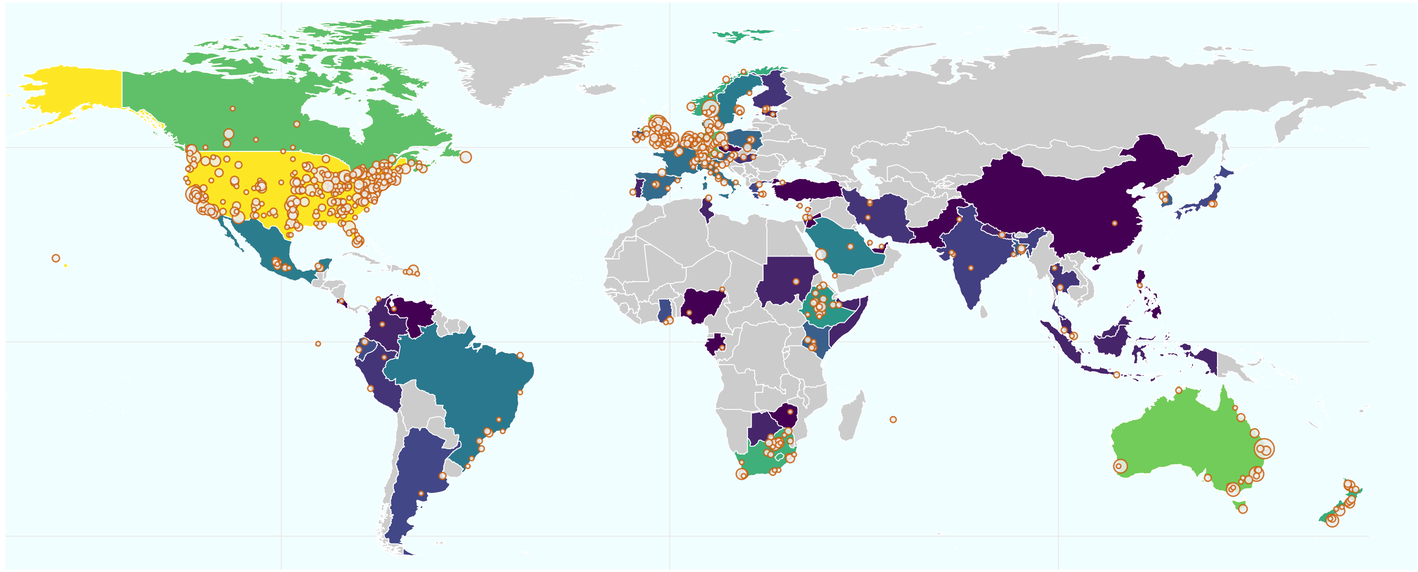
Lesson structure and teaching techniques

- Live Coding
  Instructors write code in real time, showing process and mistakes.
- Formative Assessment
  Frequent use of small exercises to gauge understanding.
- Feedback Loops
  Real-time learner input using sticky notes, polls, or tools like Etherpad.
- Collaborative Learning
  Learners help each other through pair programming and group work.

Illustration by storyset.com

Who is using the Carpentries?

- At the University of Twente:
  - Digital Competence Centre (DCC)
- In the Netherlands
  - Netherlands eScience Center
  - TU Delft, TU Eindhoven, WUR, Leiden University, etc.
  - Dutch Reproducibility Network (NL-RN)
- In the World



Source: https://carpentry.library.ucsb.edu/

Our goals in using The Carpentries

- Deliver modular, interactive, and learner-focused workshops.
- Build internal capacity by certifying instructors.
- Collaborate with others (i.e. instructors, helpers) for teaching.
- Promote open training materials for geospatial science.
- Using community-drive and up-to-date teaching materials.

Illustration by storyset.com

Our implementation at ITC

- Yearly planning by identifying training needs and knowledge gaps.
- Encourage staff to get certified via Carpentries Instructor Training.
- Promote events through employee portal, narrowcasts, LinkedIn, posters, and newsletters.
- Pre- and post-event surveys to refine content and teaching.
- Multiple helpers, live coding, collaborative document (self-hosted CodiMD).
- Formative assessment, regular reflection on learner feedback and outcomes.

Illustration by storyset.com

Our impact through training workshops in 2024*

- 10 workshops organized using The Carpentries or Carpentries-inspired teaching methods
- About 300 registrations from staff and students.
- Delivered more than 76 hours of hands-on training sessions.

List of a few courses we have organized

- Introduction of Geospatial Raster and Vector Data with Python
- Introduction of Geospatial Raster and Vector Data with R
- Good Practices for Research Software Development
- Publishing Research Data with fairly
- Publishing Spatiotemporal Data with STAC
- Introduction to Docker
- Introduction to openEO for Cloud-based Geoprocessing

Illustration by storyset.com

What participant say?

- "very good explanations, very readable code, very clear presentations"
- "flow of the training was made easier to follow"
- "the helpers really help fixing the errors and problems"
- "clear, organized, well-delivered"

- How do we use anonymous feedback?
  - Adjust pace, content depth, and examples.
  - Share back outcomes with the team to iterate.
  - Track trends across sessions.

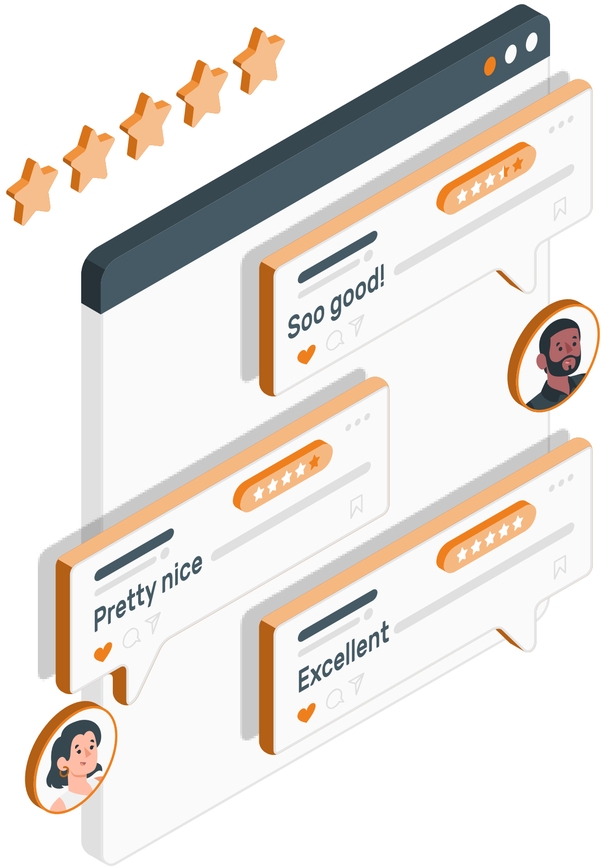


Illustration by storyset.com

What have we learned for logistics and coordination?

- Scheduling across departments/faculties can be tricky.

  Solution: Comprehensive checks with student and ITC/UT calendar

- Registration and communication require early planning.

  Solution: Sufficient time in between announcement and actual workshop

  Solution: Systematic communication through different media

- Setup (versions, dependencies) often needs extra attention.

  Solution: Emphasis on verifying setup before workshop begins

  Solution: Office hours before the event to help with the setup

- No show or last-minute drop out remain issue to be mitigated.

  Solution: Confirmation request with acceptance for workshops

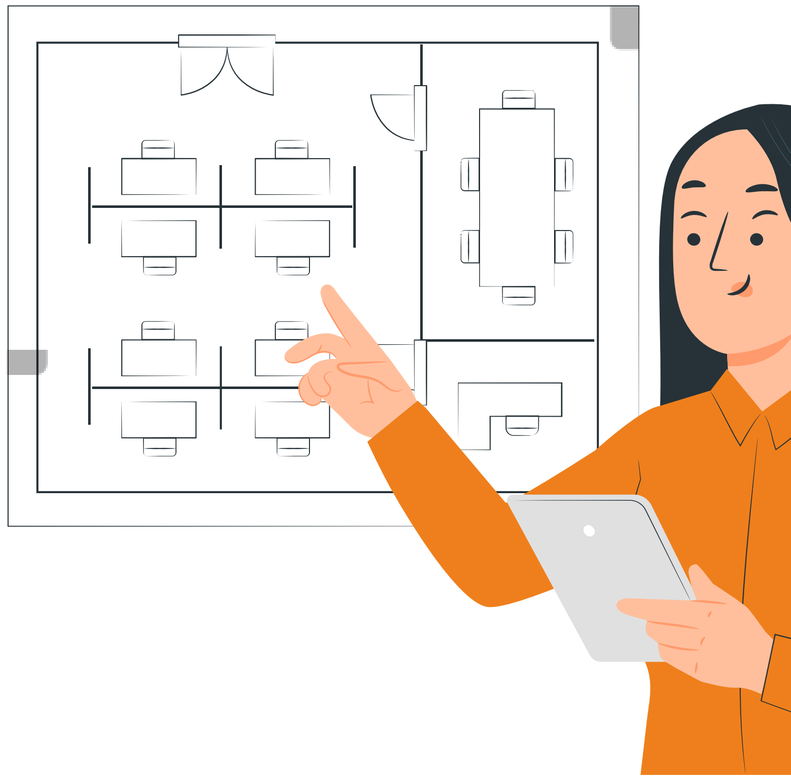


Illustration by storyset.com

What have we learned for timing and cognitive load?

- Learners can get overwhelmed if content is not paced carefully.

  Solution: Pre-workshop meeting for course material check along with results from Pre-workshop survey.

- Breaks and recap moments are essential.

  Solution: Recap placed after the breaks and completion of workshops.

  Solution: Inclusion of timely coffee breaks.

- Live coding demands high focus, both from learners and instructors.

  Solution: Helpers assisting with smooth transition from instructors to learners.

  Solution: Collaborative document used for command logging.

Illustration by storyset.com

What have we learned for balance and availability?

- Striking the right balance: Not too basic for experienced participants, not too complex for beginners.

  Solution: Use modular content, adapt live based on learner needs.

- Limited pool of certified instructors.

  Solution: We are working on training more instructors to increase capacity.

  Solution: Some sessions had to be postponed or scaled down.

Illustration by storyset.com

Want to get involved?

- Become a Carpentries Instructor
  - Gain formal teaching credentials through Instructor Training.
  - Learn how to teach code and data skills with empathy and clarity.
- Join as a Helper
  - Support instructors during workshops.
  - No teaching experience needed, just a willingness to assist.
  - Great way to get involved and build confidence!

Next Instructor Training
June 3-6, 2025 (Online)

Upcoming Workshop
June 4, 2025 (OpenEO Workshop)

Helpers are welcome!

Contact us if you want to learn more or collaborate!

Dr. Serkan Girgin

Head of Department
Center of Expertise in Big Geodata Science

Associate Professor
Department of Geoinformation Processing

s.girgin@utwente.nl
https://linkedin.com/in/serkan-girgin/

Jay Gohil

Researcher
Center of Expertise in Big Geodata Science

j.h.gohil@utwente.nl
https://linkedin.com/in/jaykumargohil/

CRIB

https://crib.utwente.nl