



Department of Geography

at the University of Wisconsin – Madison



UN-GGIM
GEOSPATIAL SOCIETIES



Unil
UNIL | Université de Lausanne
Faculté des géosciences
et de l'environnement

GEO-AI Working Group 4 – BoK

Body of Knowledge

Prof. Song Gao

Director of Geospatial Data Science Lab

Department of Geography University of Wisconsin

Madison - USA

Dr. Samantha T. Arundel

Director, Center of Excellence for Geospatial Information Science

Senior Research Advisor, National Geospatial Program

U.S. Geological Survey

Prof. Céline Rozenblat

Chair of the UN-GGIM Geospatial Societies

Vice president of the International Geographical Union (IGU)

Institute of Geography and Sustainability

University of Lausanne - Switzerland

Issues in defining a Body of knowledge in GEO-AI

In parallel with the Syllabus on GEO-AI (Working groups 1 to 3)

Supporting the GEO-AI initiative trainings

- Corresponding vocabulary
- Adapted to different levels and pathways

Up to date vocabulary

Online system enabling easy contributions and access

Main issues

⇒ **Knowledge area**

⇒ **Coordination** with existing BoK on Geographic Information Science

⇒ **Practical tools** to support users (trainers, trainees, private sector)

GEO-AI - Knowledge Area

- Spatially Explicit ML Models
- Spatial Neural Network Regression
- Geographically and Temporally Weighted Neural Networks
- Multi-Modal Spatial Contrastive Representation Learning
- ...

**Geospatial
ML & DL**

- Geo-Knowledge Graphs
- KG-Based Spatial Reasoning
- Uni- Multi-partite Graphs
- Multiplex Graphs (multi-modal)
- ...

**Geo-Knowledge
Graphs**

**Generative
GEO-AI**

- Generative Pre-trained Transformers
- Diffusion Models for Maps and Satellite Imagery Generation
- Geo-Foundation Models
- Geo-Prompt Engineering
- ...

Stewardship

- FAIR Geodata and codes
- Open Geodata and codes
- Ethics for Geodata and codes
- Understanding and developing trust
- ...

Coordination with existing BoK projects

1. GIS & T Body of Knowledge : USA University Consortium for Geographic Information Science - UCGIS

<https://gistbok-topics.ucgis.org/UCGIS>

UCGIS (1994-...): First edition 2006

- Professional hub for the academic GIS community in the United States
- full collection of 350+ Topics appears in its hierarchical structure

USA consortium contacts

Diana Sinton, UCGIS

2. EO4GEO to SPACE4GEO Body of Knowledge : European consortium to empower space data users

<https://bok.eo4geo.eu/GIST>

EO4GEO (2018-2022): EU supporting Erasmus+ action for Sector Skills Alliance

- 25 partners and 50 associates from 22 countries.
- set of tools based on a shared ontology, a training and education offer
- bridge the skills gap between the supply and demand of education and training in the space geoinformation sectors

SPACE4GEO Alliance (2023-...) European Union Commission DG EMPL and DG DEFIS

- Leveraging on the results of EO4GE
- large-scale Skills Partnership for space data, services and applications

European consortium contacts

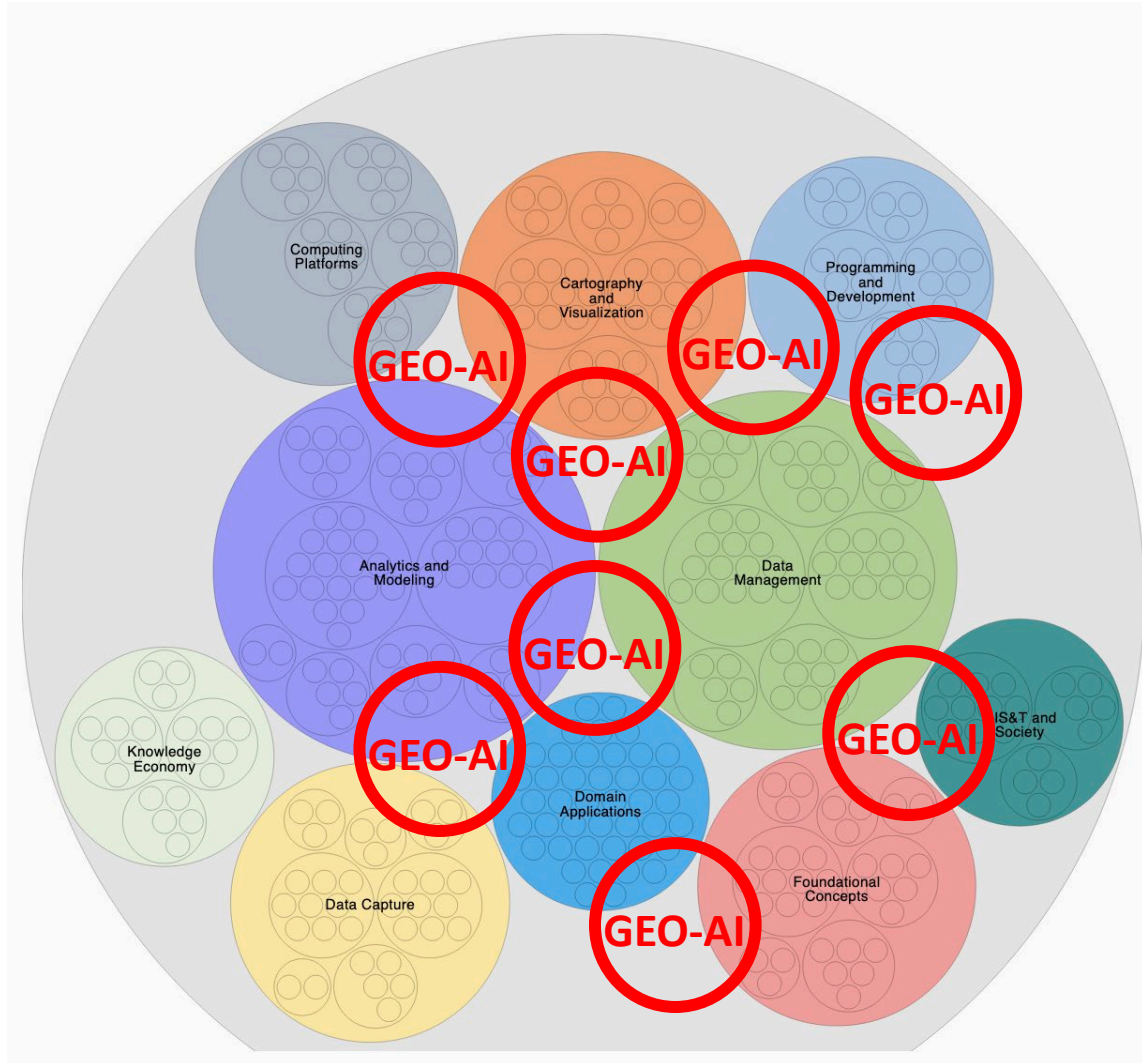
Sven Casteleyn (Spain, Univ. Castellon)

Rob Lemmens (Netherlands, Univ. Twente)

Nested structure (RDF - SKOS)

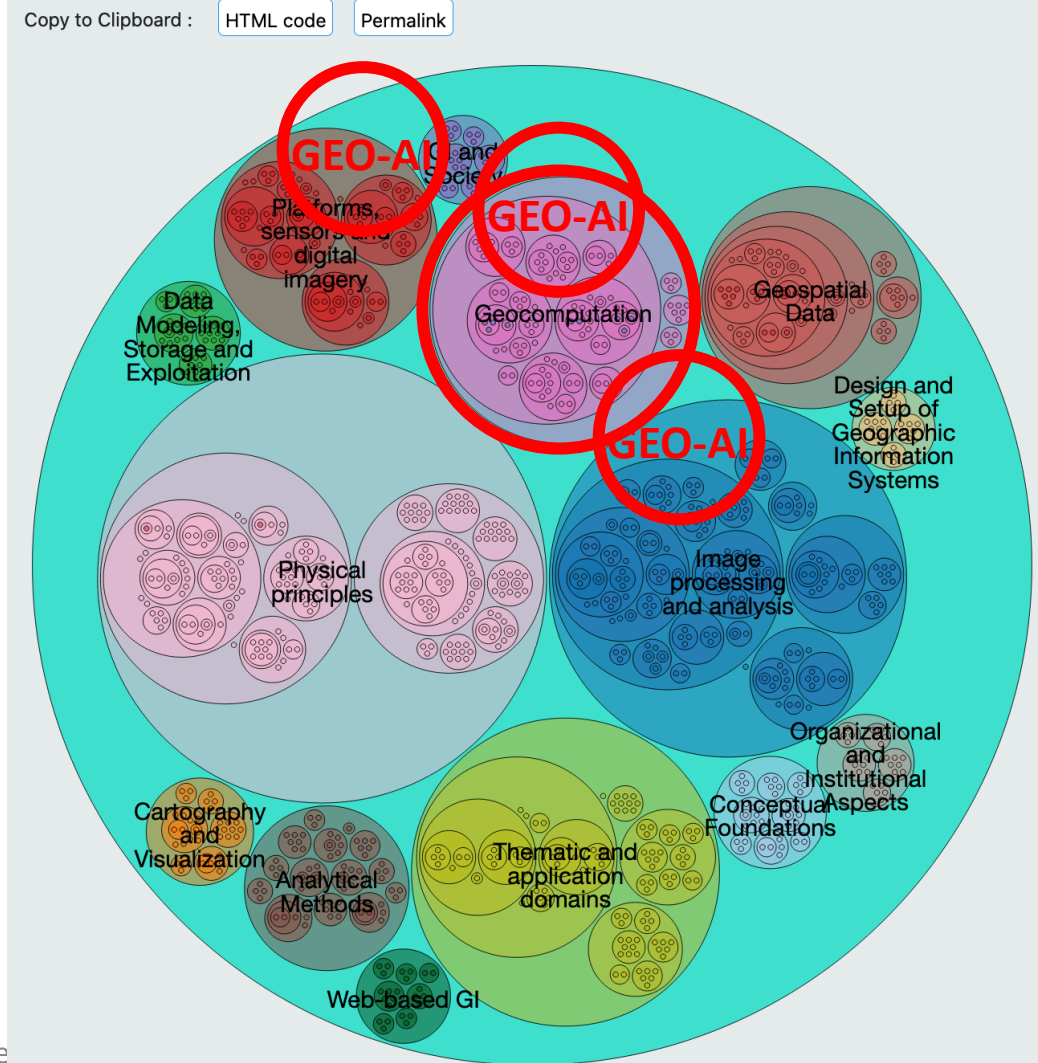
UC-GIS project GIS & T Body of Knowledge

<https://gistbok-topics.ucgis.org/UCGIS>



SPACE4GEO Body of Knowledge :

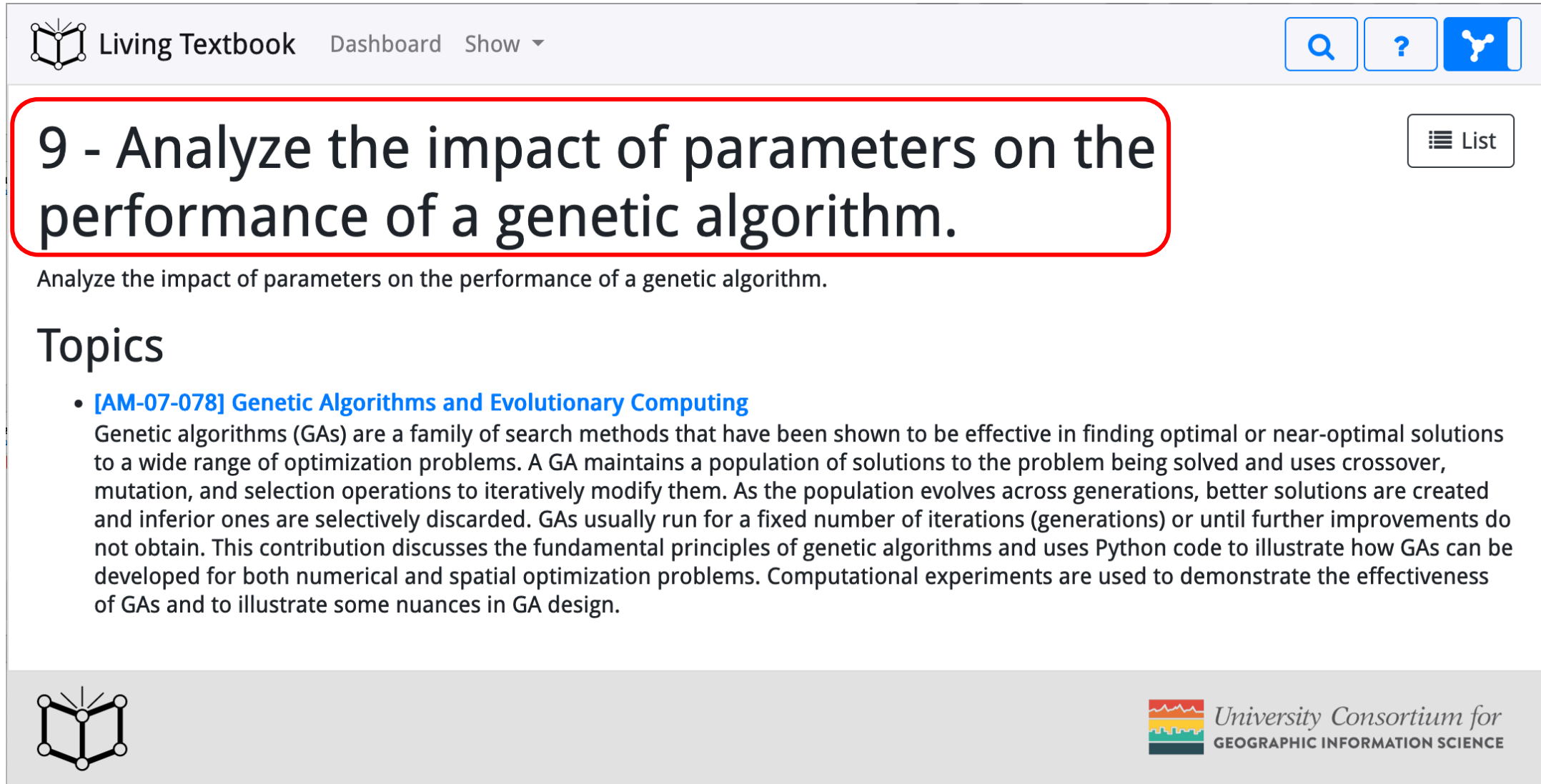
EU: <https://bok.eo4geo.eu/GIST>



Body of Knowledge

1.2 Tool of UC-GIS project GIS & T – Learning outcomes

<https://gistbok-ltb.ucgis.org/>



The screenshot shows the 'Living Textbook' interface. At the top, there is a navigation bar with 'Living Textbook', 'Dashboard', and 'Show' with a dropdown arrow. On the right side of the navigation bar are three icons: a magnifying glass (search), a question mark (help), and a person icon (share). Below the navigation bar, the main content area features a large red-bordered box containing the text '9 - Analyze the impact of parameters on the performance of a genetic algorithm.' To the right of this box is a 'List' button with a hamburger menu icon. Below the red box, there is a paragraph of text: 'Analyze the impact of parameters on the performance of a genetic algorithm.' Underneath this is a 'Topics' section with a single bullet point: '[AM-07-078] Genetic Algorithms and Evolutionary Computing'. The text of this bullet point describes genetic algorithms (GAs) as search methods for finding optimal solutions, mentioning crossover, mutation, and selection operations, and notes that the contribution uses Python code for illustrations.



University Consortium for
GEOGRAPHIC INFORMATION SCIENCE

2.2 Tool of SPACE4GEO – Living Textbook: Transversal links between competencies

<https://gistbok-ltb.ucgis.org/>

Living Textbook

Instance list

Show 25 records

Search:

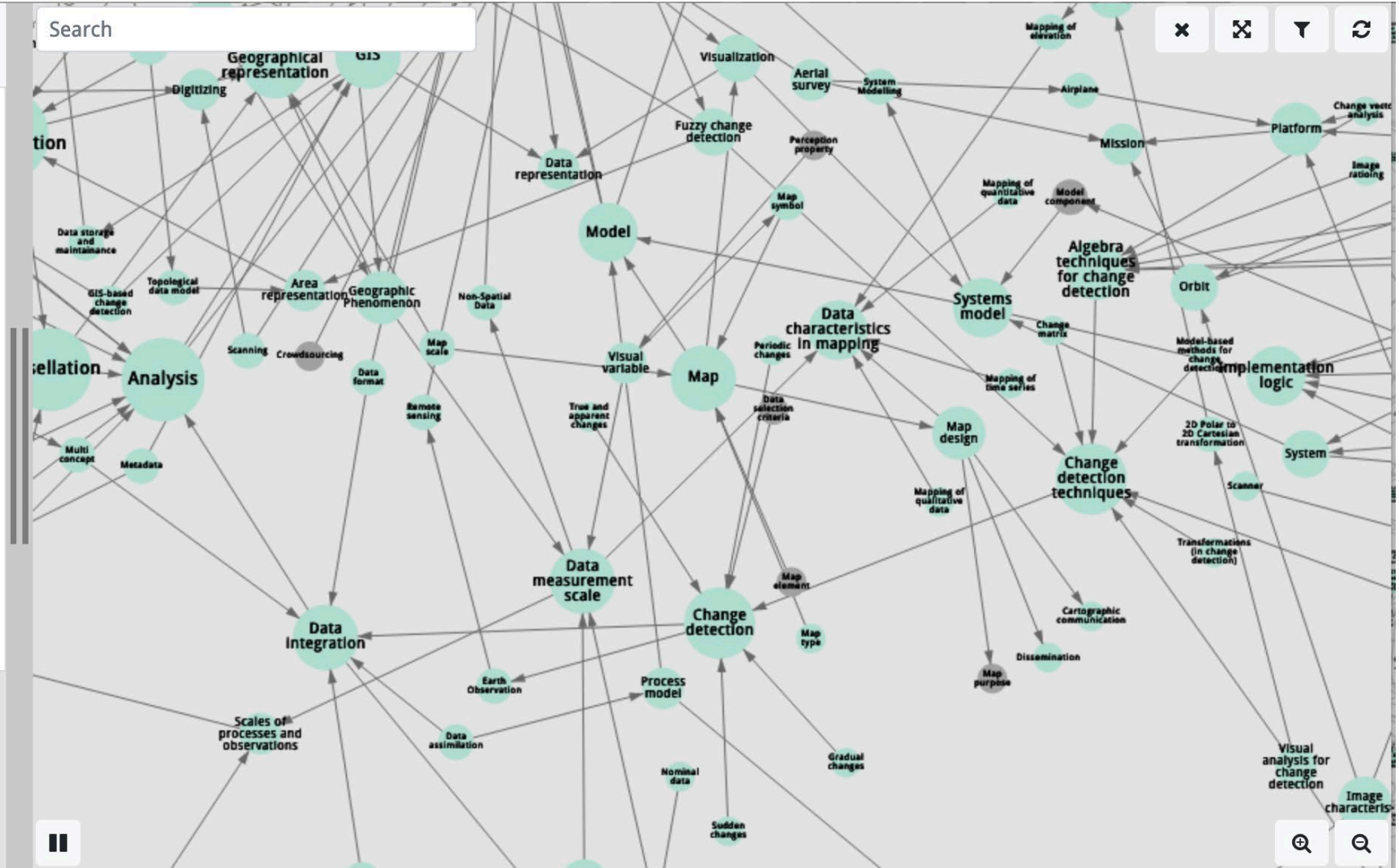
| Name | Instance | Outgoing relations |
|------------|----------|--------------------|
| No records | | |

No records to show

Previous Next



UNIVERSITY OF TWENTE.



2.3 Tool of SPACE4GEO – Learning path: chains of complementary competences

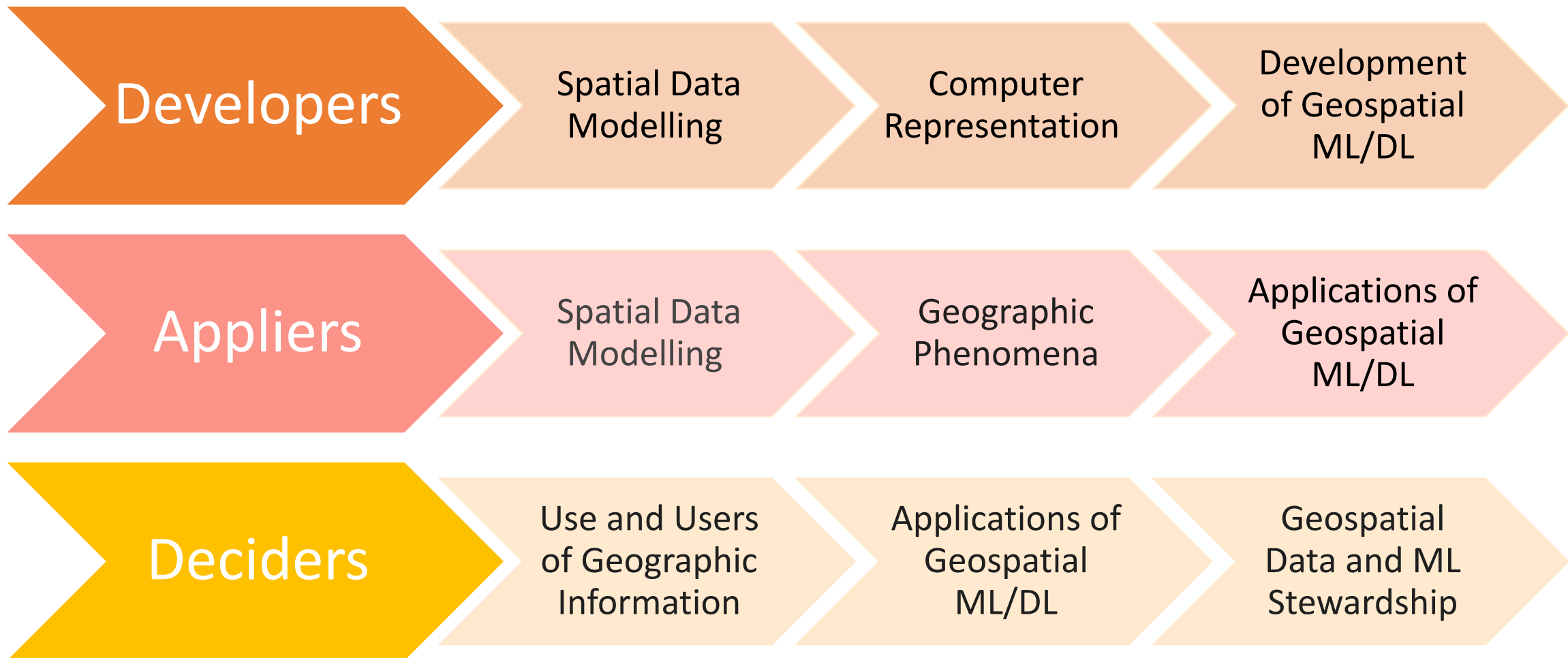
<https://ltb.itc.utwente.nl/page/498/learningpath/list>

| Name ↕ | Follow path ↕ | Actions |
|--|-----------------------------|----------------------|
| 1. 01 Spatial Data Modelling - Geographic Phenomena | Follow path | View |
| 1.02 Spatial Data Modelling - Computer Representation | Follow path | View |
| 1.02.1 Spatial Data Modelling - Topology and Time | Follow path | View |
| 1.03 Exploring Geospatial Data | Follow path | View |
| 1.03.1 Data Management : GIS and Database | Follow path | View |
| 1.03.2 Data Management : Relational Data Model | Follow path | View |
| 1.04 Spatial Referencing: Coordinate Systems and Map Projections | Follow path | View |

1.02 Spatial Data Modelling - Computer Representation



2.4 GeoAI Learning paths: chains of complementary competences



⇒ **Coordination with Syllabus of WG1—WG3**

2.6 Tool linked to SPACE4GEO – Job offer tools

<http://www.eo4geo.eu/tools/job-offer-tool/>

CURRICULUM DESIGN TOOL

OCCUPATIONAL PROFILE TOOL

JOB OFFER TOOL

BOK VISUALIZATION AND SEARCH

BOK ANNOTATION TOOL

BOK MATCHING TOOL

DATA EXPLORATION AND

ANALYSIS TOOLS

Detail

GIS specialist EO4GEO EQF 6

Geographic information systems specialists use specialised computer systems, engineering measures, and geological concepts to process land, geographic, and geospatial information into visually detailed digital maps and geomodels of a reservoir. They convert technical information like soil density and properties into digital representations of it for the usage of engineers, governments, and stakeholders interested.

Knowledge i

[AM5-6] Cartographic modeling [AM2-3] Spatial queries [CV4-9] Spatialization [DA4] Database design

Knowledge distribution

AM - Analytical Methods 50%
CV - Cartography and Visualization 25%
DA - Design and Setup of Geographic Information Systems 25%

Skills i

[AM5-6] Develop a flowchart of a cartographic model for a site suitability problem
[AM2-3] Construct a spatial query to extract all point objects that fall within a polygon
[CV4-9] Create a concept map that represents the contents and topology of a physical or social process

Transversal skills i

Attend to detail Think creatively

Specific Information i

Datasets required:

Aqua Sentinel-3 A HY-2A

Tools required:

GPS-SDR-SIM ArcGIS for INSPIRE

Language(s):

Spanish English

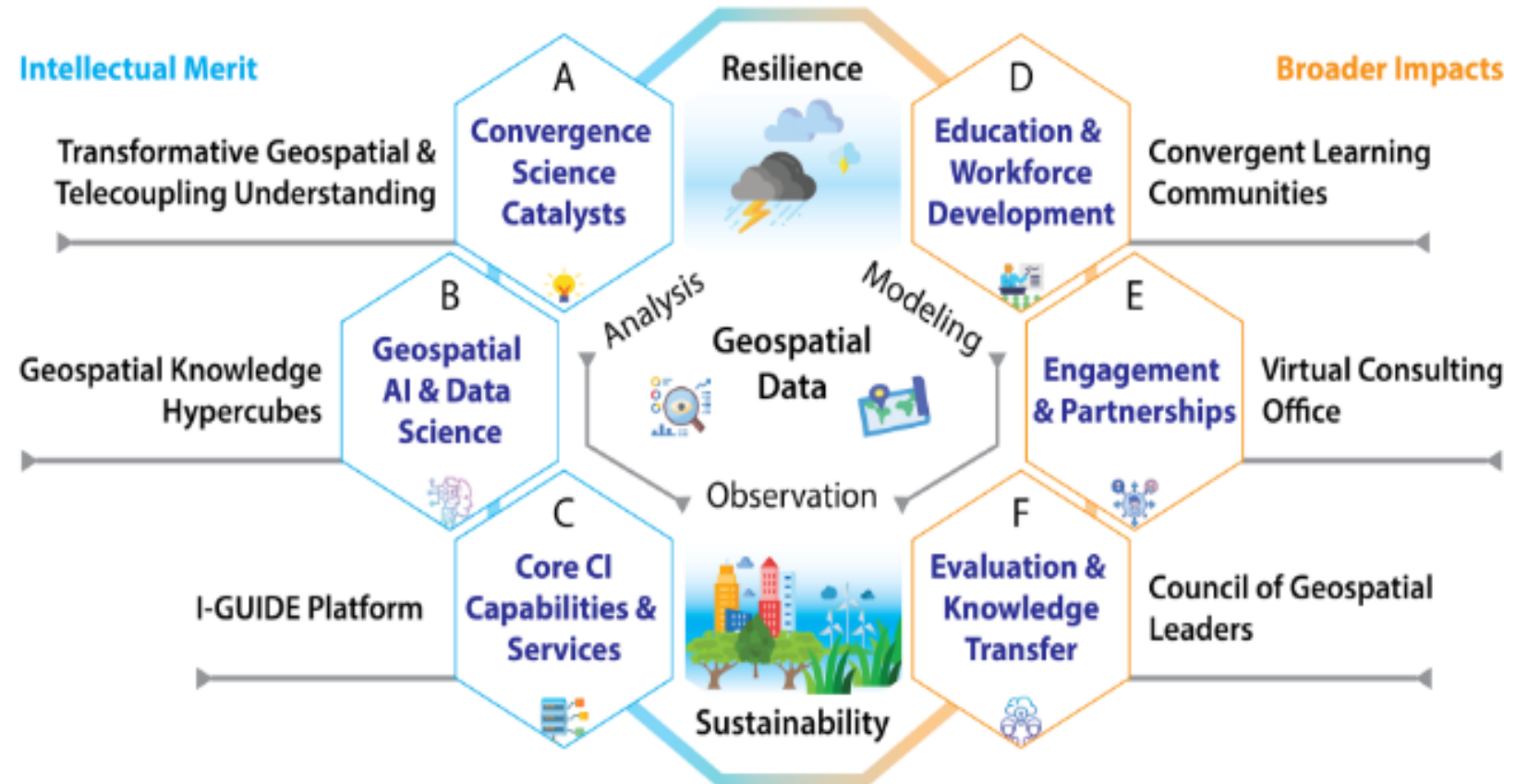
3. Other US projects: I-GUIDE

NSF Institute for Geospatial Understanding through an Integrative Discovery Environment

<https://i-guide.io/platform/>

Led by the **University of Illinois, Urbana-Champaign** + **11 US universities**:

- Columbia University
- the Consortium of Universities for the Advancement of Hydrologic Science Inc. (CUAHSI)
- Florida International University
- Michigan State University
- Purdue University
- the Open Geospatial Consortium (OGC)
- University Consortium for Geographic Information Science (UCGIS)
- University Corporation for Atmospheric Research (UCAR)
- University of Minnesota, Twin Cities
- Utah State University



GEO-AI for good BoK

- Geospatial Machine Learning and Deep Learning
- Generative GEO-AI Models
- Geospatial Knowledge Graphs
- Geospatial Data and ML Stewardship

⇒ **To be completed by the 3 working groups of Syllabus**

Coordination with both BoK existing projects

- USA: GIS & T Body of Knowledge
- Europe: EO4GEO to SPACE4GEO Body of Knowledge

⇒ **GEO-AI for good BoK in the GEO-AI Ecosystem information**

WORKING GROUP: *Song Gao, Céline Rozenblat, Diana Sinton, Samantha T. Arundel, Eva Malinverni et al.*

Thank you for your attention



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GEO-AI

Training centers Survey

Prof. Céline Rozenblat

Chair 2023-2024 of the UN-GGIM Geospatial Societies

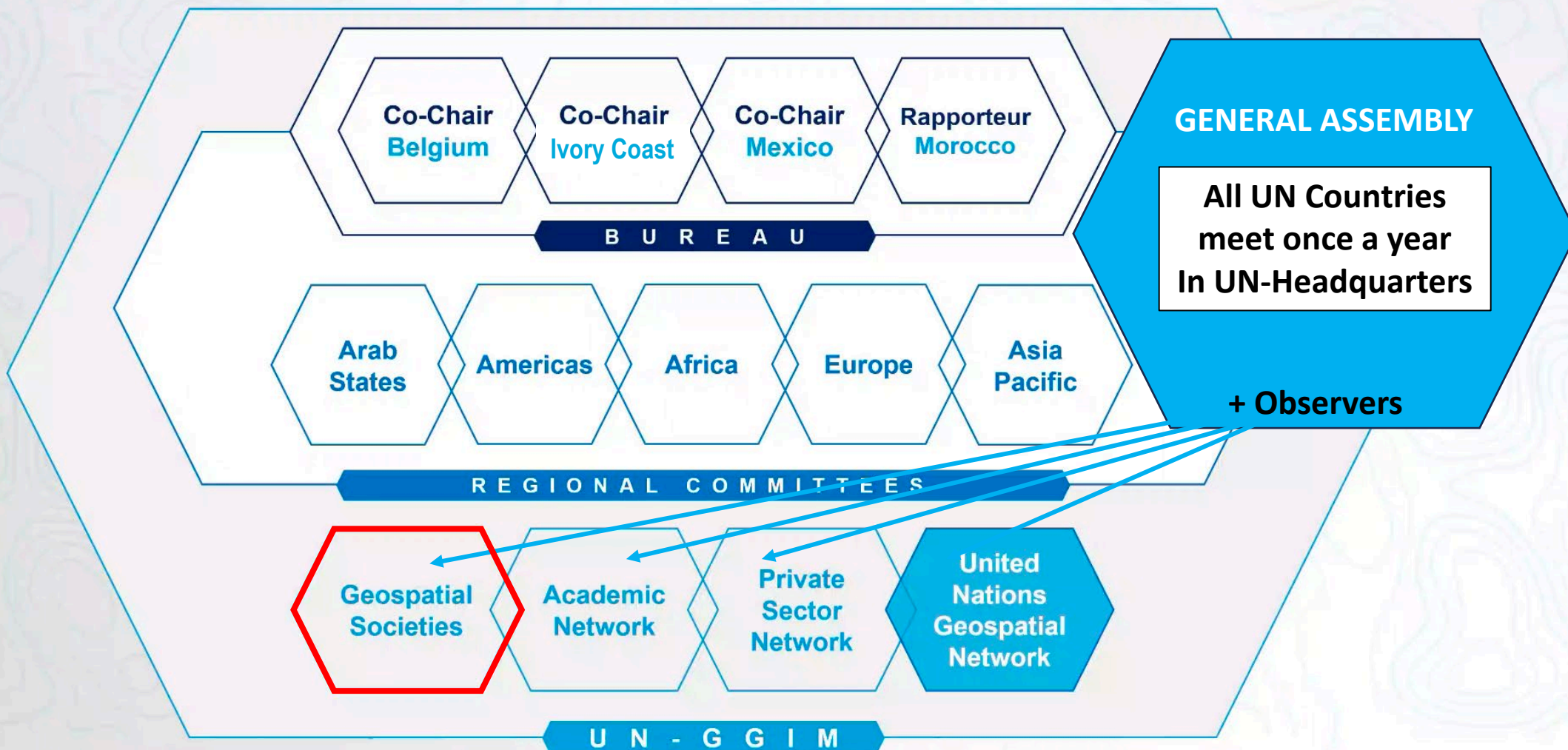
Vice president of the International Geographical Union (IGU)

Institute of Geography and Sustainability

Faculty of Geoscience and Environment

University of Lausanne - Switzerland

OUR ROLE IN UN-GGIM ARCHITECTURE



11 UN-GGIM Geospatial societies in 2024

CARTOGRAPHY

GEOLOGY

REMOTE SENSING

GEOPHYSICS

GEODESY

**PHYSICAL & HUMAN
GEOGRAPHY**

DIGITAL GEODATA

IIEE

•IEEE Geoscience and Remote Sensing Society (GRSS)

IAG

•International Association of Geodesy (IAG)

ICA

•International Cartographic Association (ICA)

FIG

•International Federation of Surveyors (FIG)

IGU

•International Geographical Union (IGU)

IMIA

•International Map Industry Association (IMIA)

ISDE

•International Society for Digital Earth (ISDE)

ISPRS

•International Society for Photogrammetry and Remote Sensing (ISPRS)

IUGG

•International Union of Geodesy and Geophysics (IUGG)

OS-GEO

•The Open Source Geospatial Foundation

ISC-CODATA

•International Science council (ISC) - CODATA

WORKING GROUPS

1. One Situation Room
2. **UN-IGIF**
3. **Inter-Agencies and Expert Group on SDGs**
4. **Geodesy**
5. Integration of Statistical and Geospatial Information
6. **Land Administration and management**
7. **Geospatial Information and Services for Disasters**
8. **Marine Geospatial Information**
9. **Policy and Legal Frameworks**
10. **Role of Standards**
11. **Toponymy**

REGIONAL COMMITTEES

- **Asia-Pacific**
- **Americas**
- **Arab States**
- **Europe**
- **Africa**

CENTERS

- Bonn (2021): **UN Global Geodetic Centre of Excellence**
- Daqing (2023): **UN Global Geospatial Knowledge and Innovation Centre**
- Riyadh (2024): **United Nations Global Geospatial Ecosystem Centre**

Geo AI Issues of training centers

Survey 2024 on training centers on GEO-AI

To support the Academic networks' GEO-AI initiative Syllabi & Body of Knowledge

Coordinating with existing training centers of Geo-AI

⇒ What exists? What do they teach?

⇒ Where? To whom? Cost and equity ?

Making a showcase of training centers on GEO-AI

To make a showcase / webpage with links to the training centers

An online questionnaire send via the Geospatial Societies

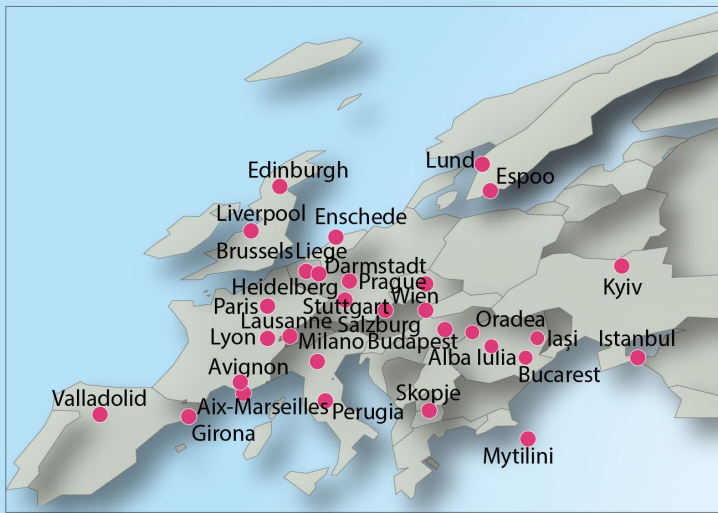
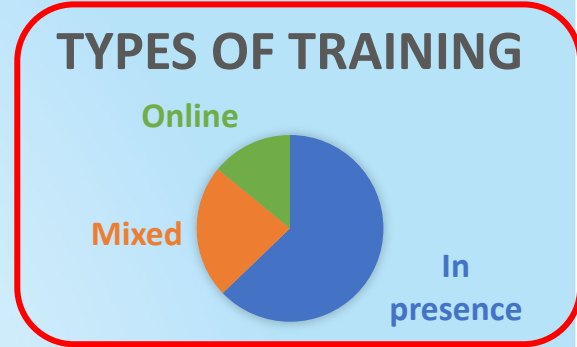
⇒ 1st round (March 2024): 68 filled questionnaires

⇒ 2nd round with a map of the first answers (June 2024): 54 new filled questionnaires

⇒ **TOTAL: 122**

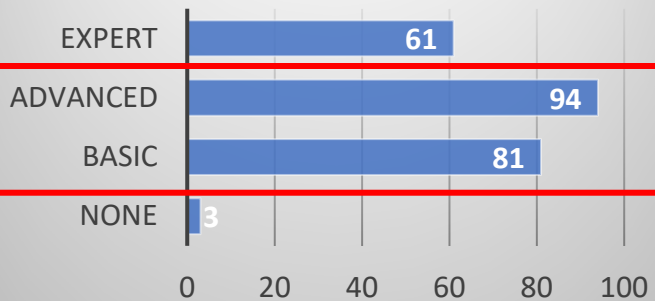
2024 - SURVEY ON GEOSPATIAL & AI TRAININGS

122 Centers (167 trainings)

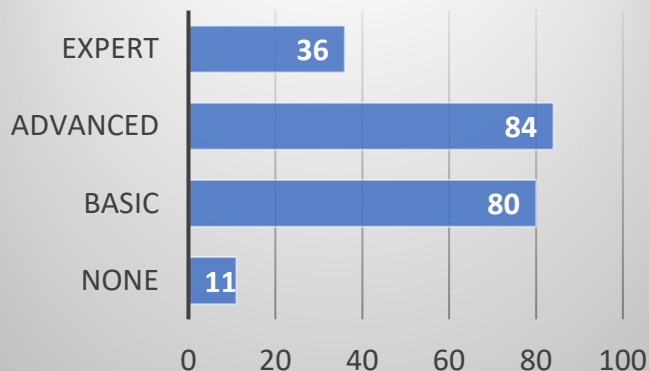


TEACHED DOMAINS (1/3)

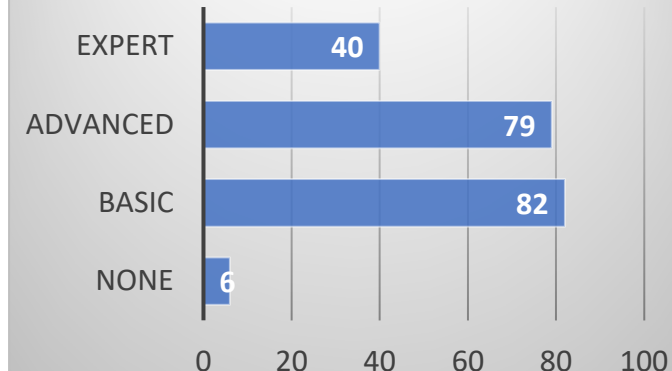
GIS / Mapping / Geovizualization



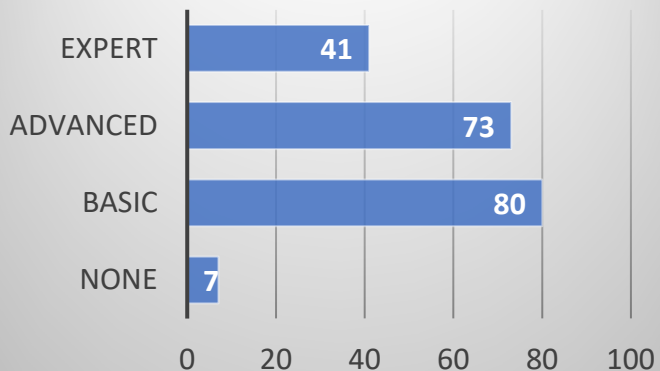
Spatial database



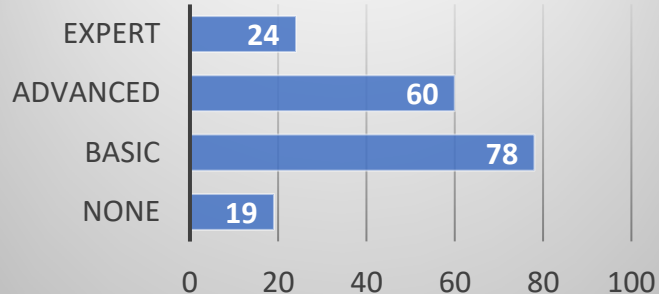
Remote-sensing



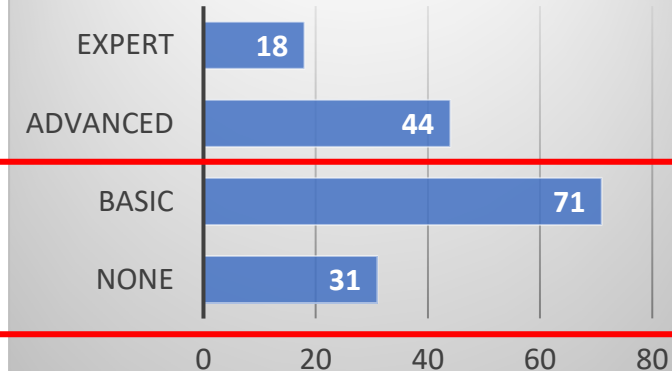
Spatial data science



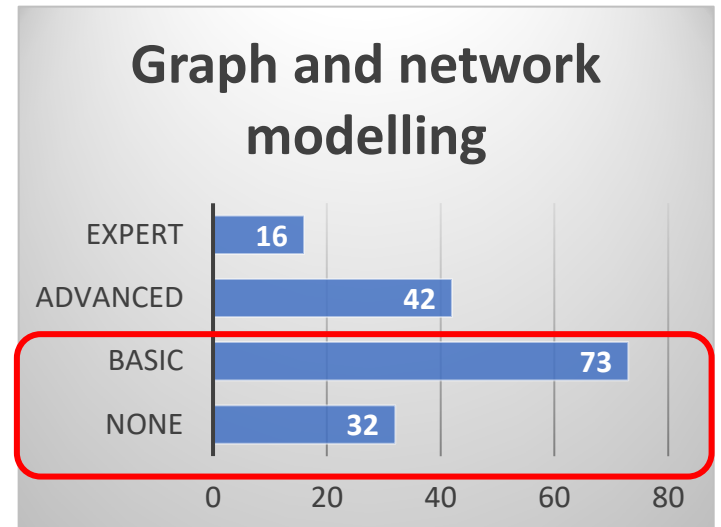
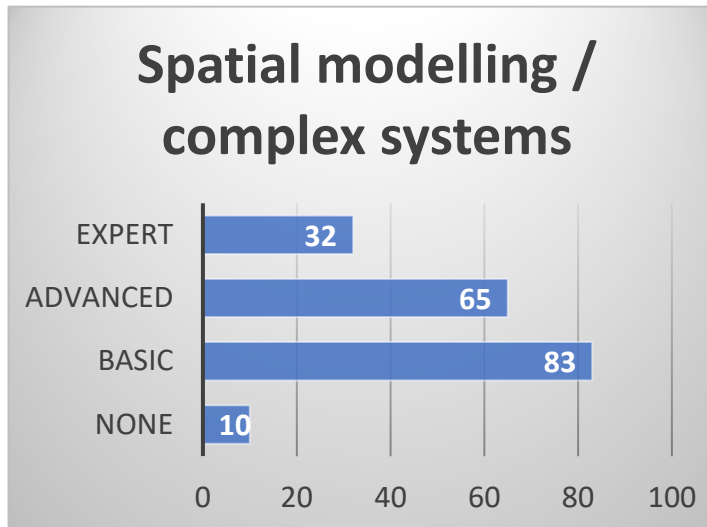
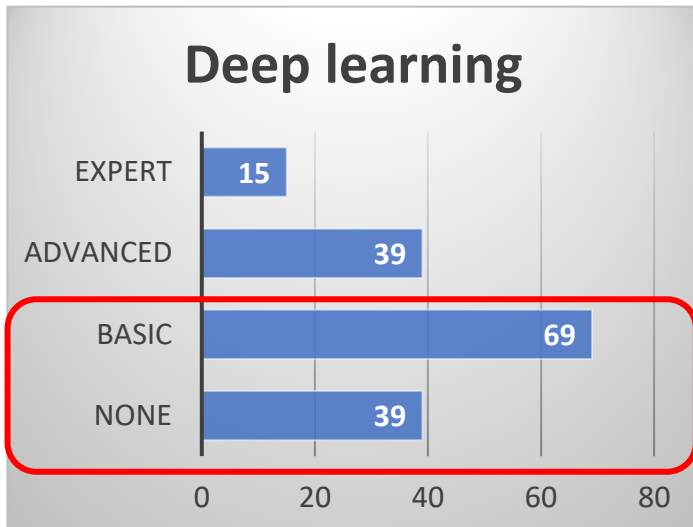
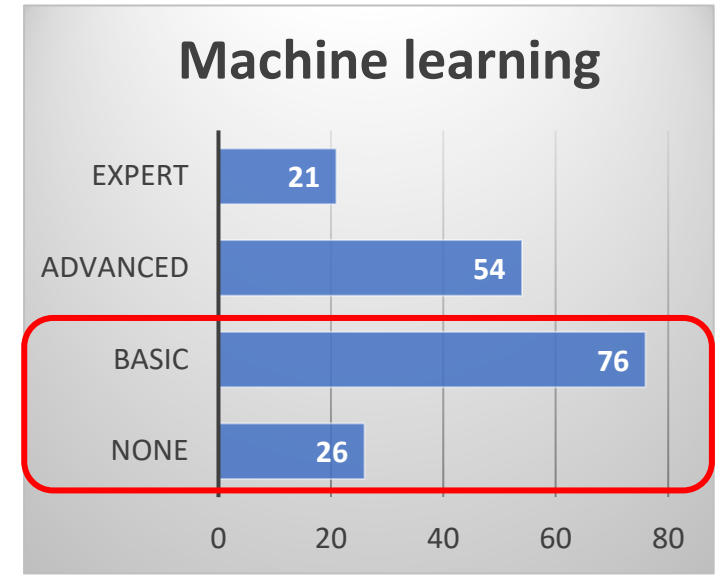
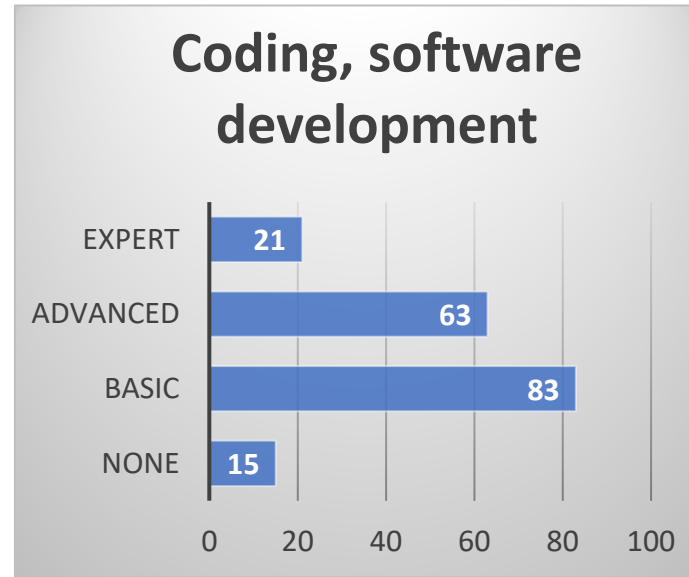
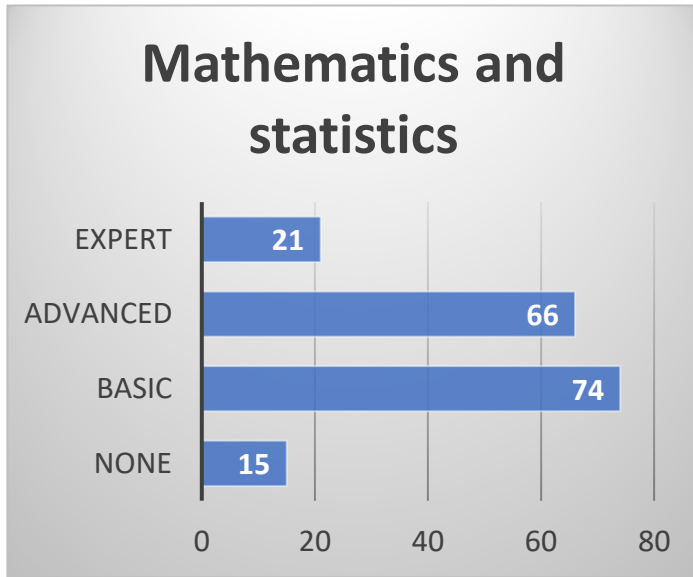
Data Engineering and management



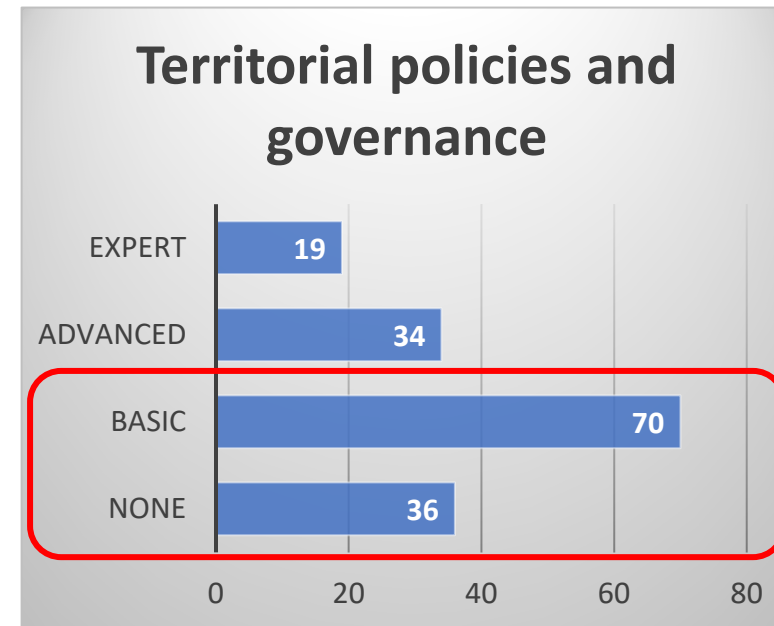
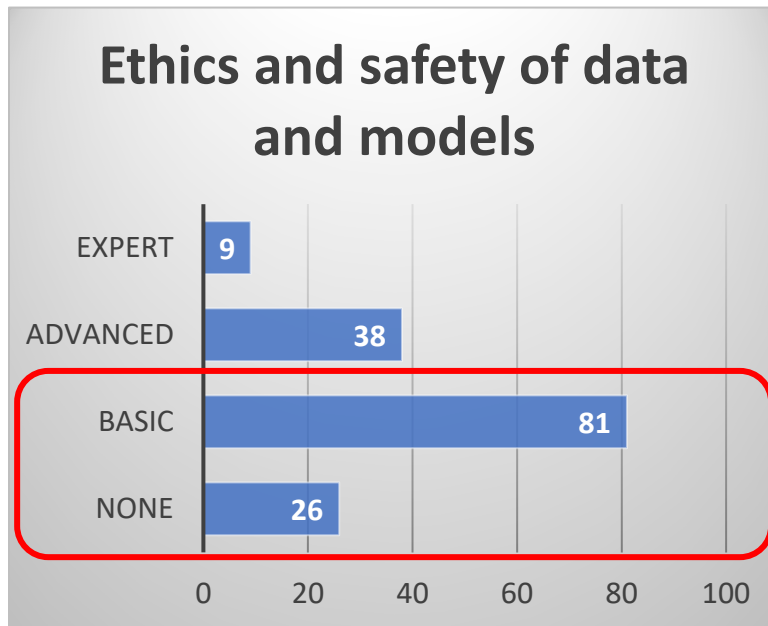
Model architecture



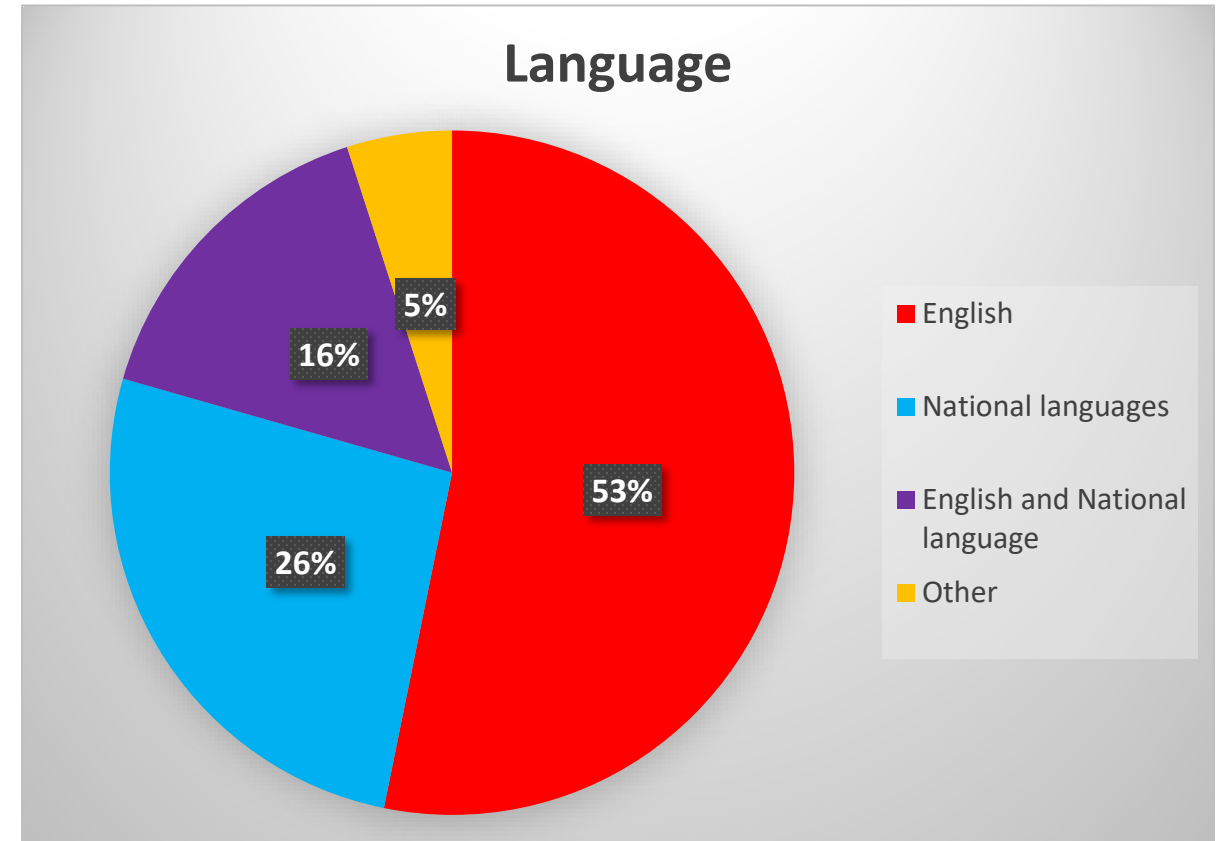
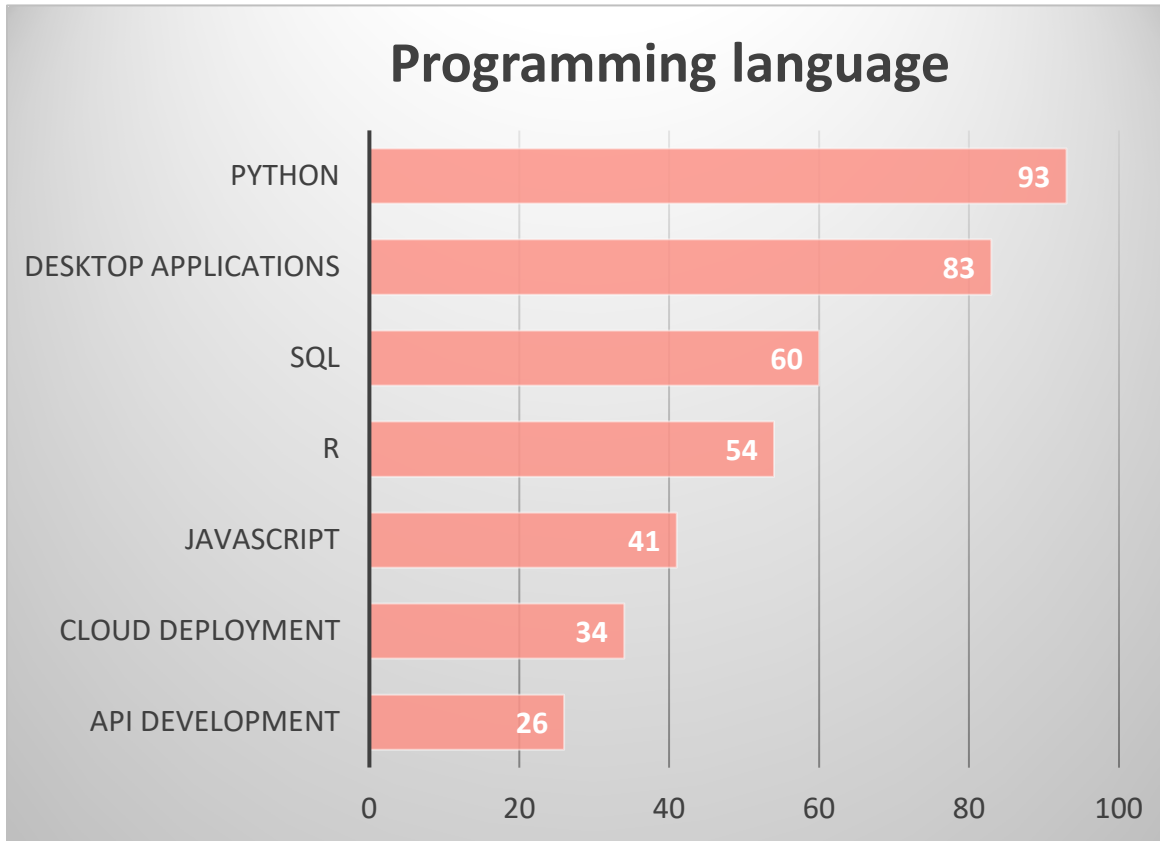
TEACHED DOMAINS (2/3)



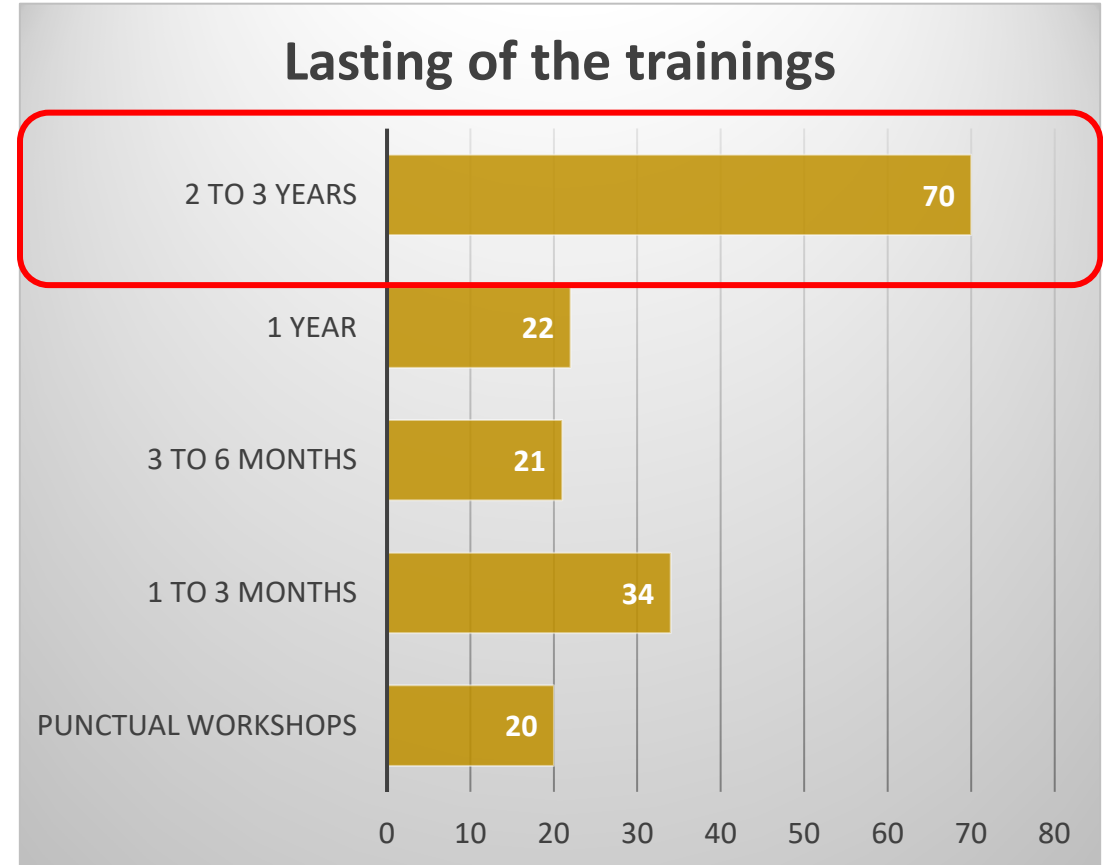
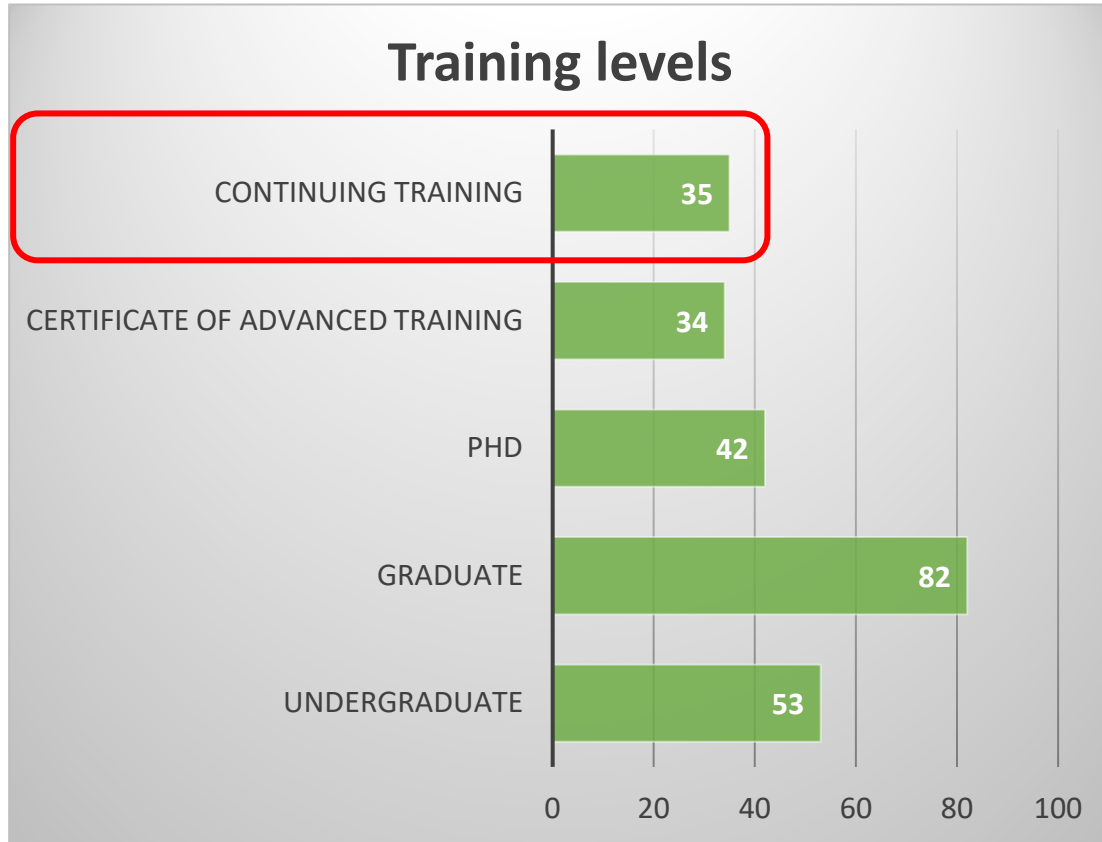
TEACHED DOMAINS (3/3)



LANGUAGES



TYPES OF TRAINING



INCLUSIVITY

Students' gender

Women: 40%

Students' nationality

Foreigners: 28% (from 1% to 100%)

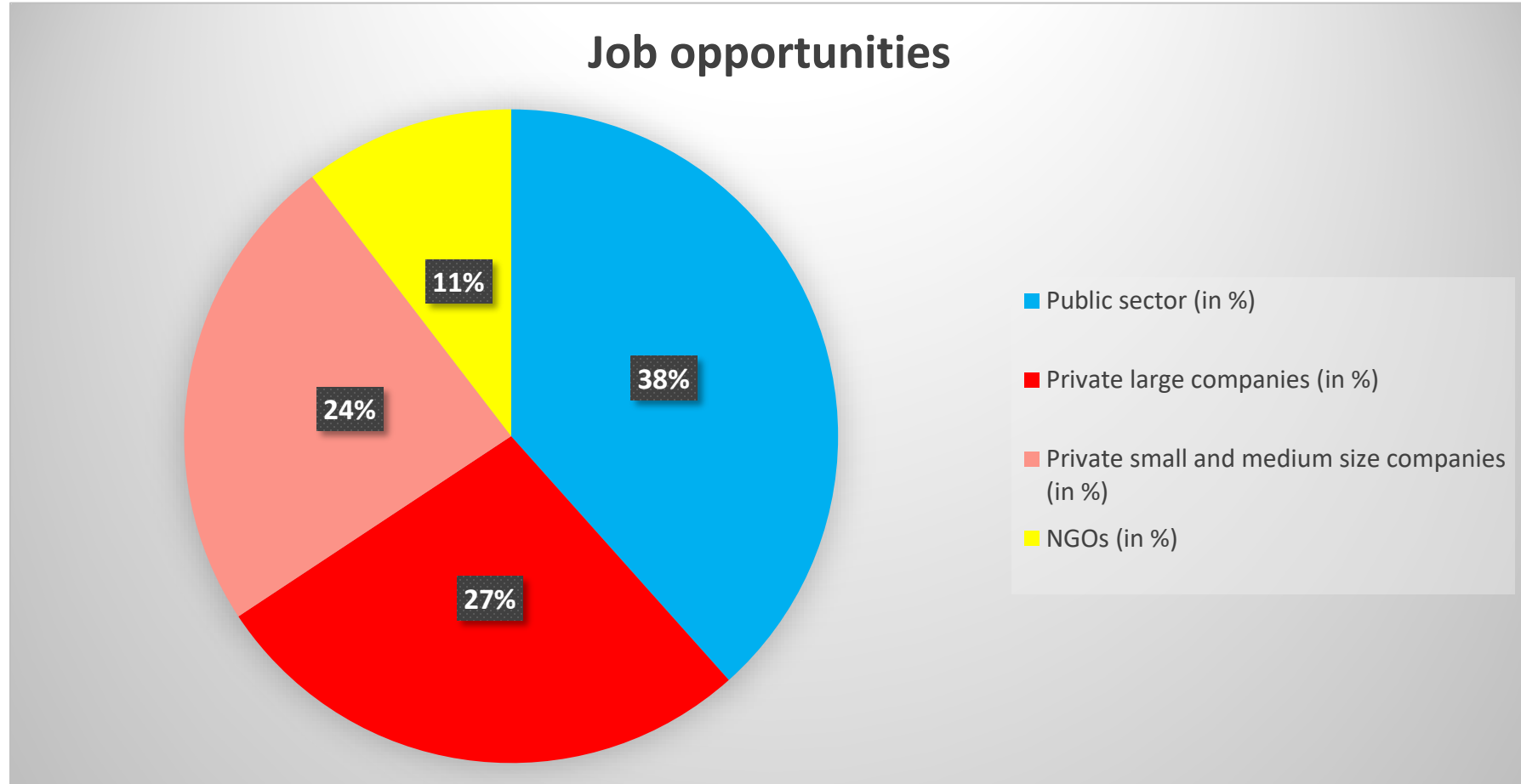
Cost of the training for 1 semester

Average: 3,000 US \$

Min: Free

Max: 16,000 US \$ (School of Engineering / Aalto University – Espoo for foreigners)

FUTURE CAREER



Representativeness

- Leadership?

Building an online platform

- Interactive map
- Directory of training centers
- ⇒ Issue of updating?
- ⇒ Open systems (VIVO – LYRASIS) + development (resources)

Sustain a worldwide community (around the UN-GGIM)

Thank you for your attention