FuseGI - “Cooperation for fusing skills on Cloud-based Open GeoInformatics: Innovative Environmental Management”

IO5

Final Curricula

Final Version 30/08/2022

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Leading Organisation of IO5: AVIGNON UNIVERSITY

Participating Organisations in IO5: DEMOCRITUS UNIVERSITY OF THRACE, EE4S, INSTITUTE OF INFORMATION AND COMMUNICATION TECHNOLOGIES, MAISON REGIONALE DE L’ EAU, INTERNATIONAL HELLENIC UNIVERSITY, HELLENIC FORESTS PARTNERSHIP (OLYMPOS PC)

INTELLECTUAL OUTPUT 5 FINAL REPORT CREATION

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SUMMARY

AVIGNON UNIVERSITE, in cooperation with DEMOCRITUS UNIVERSITY OF THRACE, EE4S, INSTITUTE OF INFORMATION AND COMMUNICATION TECHNOLOGIES, MAISON REGIONALE DE L' EAU, INTERNATIONAL HELLENIC UNIVERSITY and HELLENIC FORESTS (OLYMPOS PC), has undertaken the implementation of the project entitled "***FuseGI – Cooperation for fusing skills on Cloud-based Open GeoInformatics: Innovative Environmental management"*** under the Agreement n° 2019-1-FR01-KA203-062767 with Agence Erasmus + France, within the **"2019 Round 1 KA2 - Cooperation for innovation and the exchange of good practices KA203 - Strategic Partnerships for higher education"** Call.

This report presents the implementation and the tangible results of Intellectual Output IO5 "Final Curricula" highlighting the innovative means adopted in methodological approach to create tangible and transferable results in the Geographic Information (GI) field.

This intellectual output O5 summarizes the results of the fourth and fifth steps of the FuseGI project. This IO5 aims to provide a unique, comprehensive and fully operational learning strategy in the field of Geographic Information (GI). It is aimed at both the academic and engineering/operating communities, regardless of their entry level of knowledge but with a focus on the competency-based approach.

The IO5 builds upon the findings of IO1 using field review to locate the gap between the actual and desired market skills, IO2 assessing the gap in GIS education in the participating countries and setting a draft curricula, and IO3 researching the available cloud-based platforms, VLE applicability and opportunities for building interactive novel courses, with complementarity and not overlapping. With strong interactions between IO4 and IO5, during the necessary period of courses review and adjustment (in both contents and structure), the IO5 builds upon the IO4 training toolkit. The design of a life-long learning programme description is also proposed as a perspective option.

The IO5 is the final result of the FuseGI project and therefore summarizes the experience gained in terms of needs, methodological approaches, learning means and desired outcomes in the Geographic Information (GI) field. This capitalized experience has been gained through the enriching exchanges within the consortium but also through the interactions and feedback of external participants during this three-year interdisciplinary project.

ABBREVIATIONS

ECTS	European Credit Transfer System
GI	Geoinformatics
GIS	Geographic Information Systems
IO	Intellectual Output
QGIS	Quantum GIS
VLE	Virtual Learning Platform
VLE	Virtual Learning Environment

1 Introduction

1.1 Overall objectives, implemented activities and results of the FuseGI Project

The FuseGI consortium had identified a gap between what the academic world provides towards its teachings and what the environmental labor market requires in terms of Geographic Information Systems (GIS) skills. Skills that are nevertheless essential for environmental and health risks management.

The goal of this consortium was to conduct an in-depth study (qualitative and quantitative) on the subject and then to design, develop and make available an adapted online tool to fill this GIS skills shortage to students and young professionals for the needs of the labor market.

The FuseGI consortium is composed of experts in the fields of water management, forestry and health (from both the academic world and the private sector) as well as computer scientists capable of setting up and sustaining online training tools. It was therefore relevant from the perspective of the project. ERASMUS+ through the projects "Cooperation in innovation and exchange of best practices" was the ideal and most relevant framework to achieve a project in this direction.

The overall objectives of the FuseGI project were:

1. Establishment of a transnational, interdisciplinary and open collaboration between academia and industry within the EU to address the training needs in GIS for a better functionality and better environmental and health risks management.
2. Knowledge transfer and bridging of gaps in academic and professional experience of the partners in the use of GIS applications in different key environmental and health sectors.
3. Improved professional skills in the use of open GIS platforms for interdisciplinary collaborative data processing.
4. Development, implementation and validation of a virtual learning environment (VLE).
5. Design of the architecture of an adapted curriculum, corresponding to the needs of the market world, for master's degree courses.

The implemented activities of the FuseGI project can be resumed on:

- A quantitative research and needs analysis of GIS skills.
- The design and development of an original training course based on the results of the above analysis.
- The design and creation of a GIS training program focusing on the skills acquired . Case studies covering the fields of water management, forestry and health are also proposed to capitalize on the knowledge.
- The development of a state-of-the-art virtual learning environment (VLE), scalable, free, available and open to all, to host the GIS training program.

- Testing and validation of the architecture and materials developed through three pilot training activities that took place in three different countries at different phases of the project as well as the transdisciplinary cross-section of consortium members and our partners.
- The finalization of an adaptive international curriculum (from postgraduate to continuing education for engineers) targeting skills acquired in GIS.
- Dissemination activities through the organization of three multiplier events in three different countries and through the exploitation of social networks and other communication channels (such as mailing lists, etc.).

The concrete results of the FuseGI project can be resumed as following:

- ✓ Carrying out a survey towards academics and professionals, in the relevant environmental fields, through questionnaires, mainly within the 3 EU countries, to gather information on the needs for GIS skills in the labor market.
- ✓ Documentation of the current situation in universities of three European countries regarding GIS courses offers
- ✓ Design/development of a curriculum skeleton that can cover the previously identified needs.
- ✓ Development of a virtual learning environment (VLE) that enables communication and collaborative learning, including forums, chat rooms and interactive online assessment, to support distance learning.
- ✓ Creation of a training toolkit within the learning platform with GIS training materials that uses case-based learning principles.
- ✓ Completion of a comprehensive GIS skills-based curriculum ready for application in university programs or for use by professionals (e.g., continuing education, GIS updates).
- ✓ Implementation of an effective network to strengthen cooperation between partner organizations and promote modernization of Europeans universities.
- ✓ Accessibility to all materials and courses created by the consortium as part of the project, which are open source.

Five transferable, innovative and tangible outputs resulted:

IO1: Research and field review
IO2: Draft Curricula
IO3: Learning platform
IO4: Training toolkit
IO5: Final Curricula

1.2 Interrelations of project Intellectual Outputs

The concept and the methodological approach of the FuseGI project allowed strong interactions between all intellectual outputs. Each intellectual output represent an innovative, transferable and tangible result also as a necessary step for the project finalisation.

The following scheme (fig.1) represent the interrelations and connectivity of the FuseGI intellectual outputs.

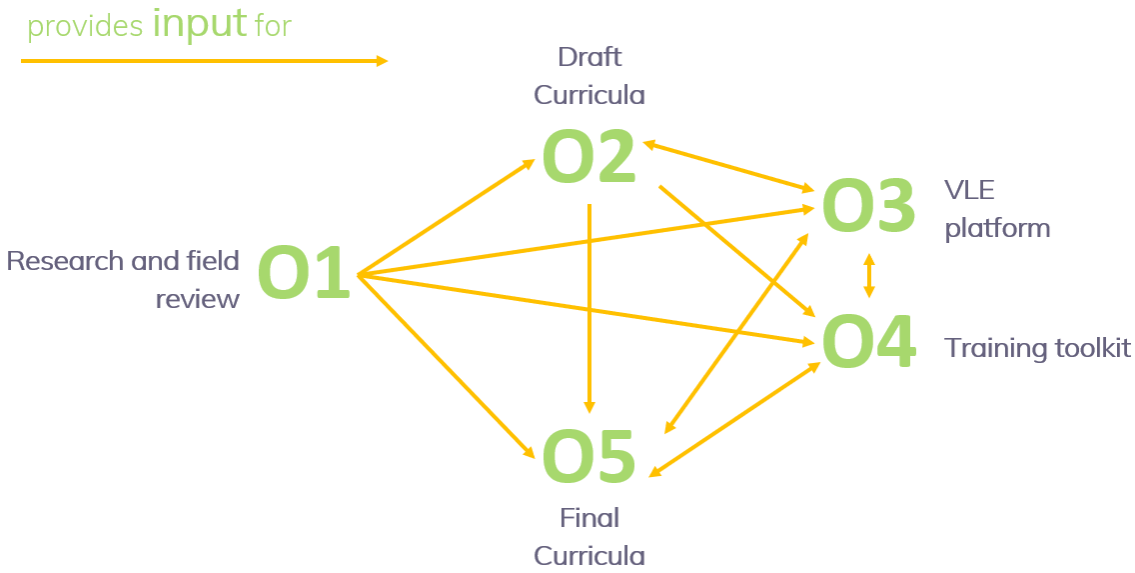

Figure 1 : Scheme of interrelations of FuseGI intellectual outputs

The IO5 as a final result of the FuseGI project is the converging point of all intellectual outputs. It is also the result of active interactions with participants (e.g., students, teachers, researchers, public and private sector professionals, etc.) during short interviews and focus groups that were organized during the project's training and dissemination events. The IO5 builds upon the findings of IO1 using field review to locate the gap between the actual and desired market skills, IO2 assessing the gap in GIS education in the participating countries and setting draft curricula, and IO3 researching the available cloud-based platforms, VLE applicability and opportunities for building interactive novel courses, with complementarity and not overlapping.

With strong interactions between IO4 and IO5, during the necessary period of courses review and adjustment (in both contents and structure), the IO5 builds upon the IO4 training toolkit.

Indeed, during O5, the review of all the educational material by the consortium members (cross-cutting view) and by the project partners (through the different learning and dissemination events and the associated feedback) took place. This critical review guided an adjustment of the pedagogical architecture and in particular an adaptation/modification of the teaching courses (results of IO4) to ensure the competence-based approach. Finally, the design of a life-long learning programme description is also proposed as a perspective option.

1.3 Scope and Objectives of Intellectual Output 5

The intellectual output O5 represents the capitalization of all the reflections, works and deliverables realized during the FuseGI project. The IO5 aims to provide a unique, comprehensive and fully operational learning strategy in the field of Geographic Information (GI). It is aimed at both the academic and engineering/operating communities, regardless of their entry level of knowledge but with a focus on the competency-based approach.

This intellectual output O5 summarizes the results of the fourth and fifth steps of the FuseGI project. It includes:

- the general structure of the modules and the structure of the targeted skills (competency tree)

- the objectives and the description of each course as well as the related acquired skills

- the tasks or situations that allow for the observation of the trainee performance.

1.4 Structure of Intellectual Output 5

The content of this report is organized as shown below.

1st section provides an introduction that refers to all the project outputs, the overall objectives and results, the interrelations between IOs, as well as the specific scope and objectives of this intellectual output (IO5).

2nd section delineates the methodological approach adopted for the IO5 production.

3rd section details the overall presentation of the final curricula based on the competency-based approach and presents the description, objective and the acquired skills of each course.

4th section presents, as a complementary perspective, the description of a life-long learning program.

5th section explains the innovative, tangible and transferable characteristics of the intellectual output IO5.

1.5 Intellectual Output 5 Sub tasks

IO5 Sub task
First version of the Final Curricula
Review of the structure and the content of final curricula based on the competency based approach
Feedback analysis from dissemination (E2 and E3) and training activities (C2 and C3)
Second review phase of the structure and the Final Curricula development

2 A competency-based approach for GIS learning

The concept of competency is a pillar of curriculum development and a driving force behind the process of change. It is defined as “the development of complex capacities that enable students to think and act in various fields of activity […]. It consists of achieving knowledge in action, the result of a sound knowledge base that can be put into practice and used to explain what is happening” (Braslavsky, C.). The FuseGI consortium decided to focus on this competency-based approach during the fourth and fifth project’s phase. This decision was guided thanks to the active interactions with participants (e.g., students, teachers, researchers, public and private sector professionals, etc.) during short interviews and focus groups organized during the project's training and dissemination events. It reflects also the maturation of this interdisciplinary project’s goals within the consortium.

The Final Curricula is designed to promote and ensure a competency-based approach for GIS learning. It is aimed at both the academic and engineering/operating communities, regardless of their entry level of knowledge but with a focus on the required skills. In contrary of the classical knowledge-based approach, this method is tailored to meet different learning abilities and can lead to more efficient trainees’ outcomes. Thus, the trainees will be able, regardless of their initial level and understanding in GIS to undertake the course aiming at specific required skills. This will result for universities in improved skills and employability of students and for the engineering/operating communities in updated technological skills and improved work deliverables.

As an example, we present six different scenarios (not exhaustive) for the utility of the Final Curricula developed thanks to FuseGI project competency-based approach:

For universities:

- It can be implemented the way it is for undergraduate or master level degrees courses
- A part of it can be used regarding the specific formation’s needs and the targeted skills
- It can be used as supporting extra material to the existing universities courses

For the engineering/operating community:

- As an assessment tool for new recruits
- As a GIS training tool for new recruits
- As an up to dat tool for the current working staff (either for a full GIS training or for specific skills acquisition)

3 Final Curricula

3.1 Overall presentation

The Final Curricula is divided into 9 courses and 4 case studies promoting 3 skills levels in GIS training with focus on water, health and forest sciences:

- A first "**discovery**" level for people learning GIS for the first time and acting as a reminder for more experienced GIS users,
- A second **"getting started"** level with the goal to understand and know how to manipulate all kinds of tools available with the open-source software QGIS, but also to use online GIS tools,
- A third **"Advanced use"** level that allows a better appreciation of the value and put into practice GIS for real-world studies involving hydrology, health, and land-use management and preservation.

This GIS training represents a medium of **40 hours of personal work** for users (depending on their level at start-up), including courses as well as case studies. For training of this size, **1 to 2 ECTS credits** may be allocated to this teaching unit depending on the user and the formation.

The following tables (**Table 1** and **Table 2**) presenting the architecture of the FuseGI Final curricula. In details:

Table 1 summarize the 9 courses by presenting for each course, the target skill level, the duration of the activity and the acquired skills in GIS by the end of the activity.

Table 2 summarize the 4 case studies by presenting for each case study, the targeting level, the specific objectives, the duration of the activity and the acquired skills in GIS by the end of the activity.

It is important to highlight that the indicated duration for each proposed activity (both courses of case studies) is highly dependent on the initial level and the skills of the trainee also as the working effort and concentration.

***Table 1** : Summary of the courses available on the FuseGI VLE platform, their required level, the duration of each and the skills acquired at the end of the activity.*

Activity	Targeted level	Duration	Synthesis of the developed GIS skills
Course 1 – GIS Introduction	Level 1: Discovery	40 minutes + 10 minutes (test)	Analyze the needs and the data to be integrated into a GIS project
Course 2 – Spatial Data	Level 1: Discovery	1 hour + 15-20 minutes (test)	Manage the data to be integrated and define the associated layers to conduct a GIS project
Course 3 – QGIS Introduction	Level 2: Getting started	50 min + 20 min (installation) + 15 min (test)	Create a project and use the basics of the QGIS software (coordinates, creation of layers, adding data, backup)
Course 4 – Georeference, Digitizing, Editing Tools	Level 2: Getting started	1 h 10 + 20 minutes (test)	Georeferencing process, creation of Shapefile layers (polygons, lines, points) in order to digitize spatial elements (example: drilling points, crop areas). Getting started with the attribute table
Course 5 – Spatial Analysis	Level 2: Getting started	1 hour + 20 minutes (test)	Analysis of different software that can be used for data analysis (QGIS, GRASS, SAGA). Getting started with the "buffer", "intersection", "union" and "clip" tools
Course 6 – Maps and Cartography	Level 2: Getting started	1 h 10 + 20 minutes (test)	Creation and customization of cartographic representation
Course 7 – Grass GIS	Level 3: Advanced use	1 h 10 + 20 minutes (test)	Getting started with GRASS GIS software to analyze raster layer data
Course 8 – Hydrological Analysis, QGIS Tools	Level 3: Advanced use	1 hour + 20 minutes (test)	Use of hydrogeology-specific tools such as SAGA software; creation of DEM (Digital Elevation Model); Data processing to create the cartographic representation of a watershed
Course 9 – Web Scraping Applications in QGIS	Level 2: Getting started	1 hour	Acquire data online and get started with online tools (Webscrapping, Datawrapper)

The 4 case studies have a realistic and precise objective: to reinforce through practice the GIS skills acquired during the courses as well as to develop new more technical-oriented up-to-date skills with a focus on the FuseGI project's thematic pillars (Water, Forest and Health).

***Table 2**: Summary of the case studies available on the FuseGI VLE platform, the target level, the objectives of the activity as well as the skills acquired as a result of them.*

Activity	Targeted level	Objective	Duration	Synthesis of the developed GIS skills
Case Study – LULC/Forest	Level 3: Advanced use	Mapping changes in forest cover for sustainable management	9 hours	Analyze, process and map forest change data for sustainable system management
Case Study – Hydrology 1	Level 3: Advanced use	Monitoring of changes in a water body and alterations to its hydromorphology in order to target the consequences on the coastal habitat zone of the lake and the use of these lands	9h30	Analyze and process surface water evolution data over time
Case Study – Hydrology 2	Level 2: Getting started	Hierarchy of watercourses in a French territory according to their sensitivity to thermal variations in the perspective of climate change	3h00	Effective use of the attribute table to classify rivers in anticipation of climate change
Case Study – Health	Level 2: Getting started	Spatial distribution of vaccination within a European city to create a targeted vaccination campaign	3h30	Analysing and processing spatial and attribute data online on a European population

The **Figure 2** graphically illustrates the "tree of skills" obtained through the proposed activities of the Final Curricula. The "tree of skills" is an alternative and interactive way that allows to a. demonstrate the evolution of GIS skills throughout Final Curricula activities and b. to understand the required activities when targeting specific technical GIS skills.

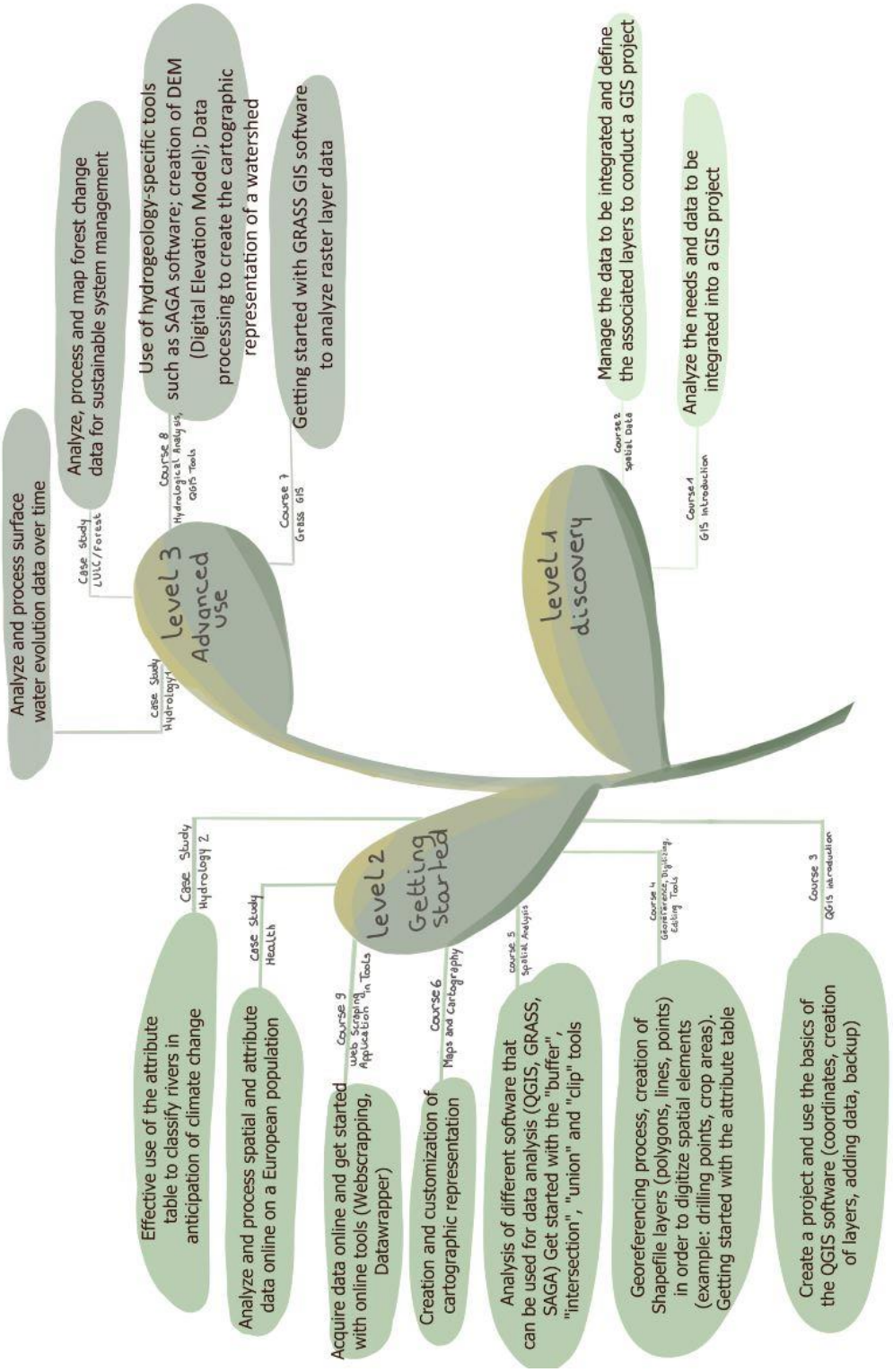

***Figure 2** : "Tree of skills" obtained through the proposed activities of the FuseGI Final Curricula.*

3.2 Courses Curricula

In the following parts the **identity card** for **each course** is provided presenting an **overview** of the course, its **content**, the **targeted skills**, the **estimated course duration** as well as the links to the FuseGI VLE platform.

It is important to highlight that the **indicated duration** for each proposed activity (both courses of case studies) is **highly dependent on the initial level and the skills of the trainee also as the working effort and concentration**.

1. GIS Introduction

Course overview

The course introduces the basic concepts of GIS, provide an perspective vision of GIS history and key development points, an overview of the applications and the questions that GIS can answer. A synopsis of the available GIS sotware is proposed and a benefits analysis is presented.

Course structure

- Definition and basic concepts
- The history of geographical information systems
- GIS applications and uses
- Questions GIS can answer
- GIS software
- Benefits and advantages

Level 1

Discovery

Targeted skills

- ✓ Raise awareness about GIS potential and use benefits
- ✓ Analyze the needs and the data to be integrated into a GIS project

Course duration

40 minutes + 10 minutes (self-evaluation test)

Link to FuseGI VLE course material

https://fusegi.cs.ihu.gr/vle/course/view.php?id=3

Link to FuseGI VLE self-evaluation quiz

https://fusegi.cs.ihu.gr/vle/mod/quiz/view.php?id=12

2. Spatial Data/ Spatial Models

Course overview

The course offers a comprehensive vision of the nature and the importance of the spatial data used for a GIS project. It develops the geographical related features the can be connected with geometric elements. The courses also defines raster and vector models. A selection criteria for selecting raster and vector models and a comparison between the two models is provided.

Course structure

- Nature of spatial data
- Descriptive attributes
- Layers and objects
- Spatial data models
- Vector and raster models / Selection criteria
- Comparison

Level 1

Discovery

Targeted skills

- ✓ Develop a strategy on data collection
- ✓ Manage the data to be integrated in a GIS project
- ✓ Define the associated layers to conduct a GIS project

Course duration

1 hour + 20 minutes (self-evaluation test)

Link to FuseGI VLE course material

https://fusegi.cs.ihu.gr/vle/course/view.php?id=5

Link to FuseGI VLE self-evaluation quiz

https://fusegi.cs.ihu.gr/vle/mod/quiz/view.php?id=123

3. QGIS Introduction

Level 2

Getting started

Course overview

The course introduces QGIS: the most popular, free, open source and scalable GIS software. The necessary steps from downloading the software, to managing a GIS project, to selecting plugins and data and layer properties are presented.

Course structure

- About QGIS
- Setting up QGIS
- Running QGIS
- Plugins
- Coordinate Reference System
- Open Data
- Layer Properties
- Saving / Printing

Targeted skills

- ✓ Create a project and use the basics of the QGIS software (coordinates, creation of layers, adding data, backup)
- ✓ Search and download necessary plugins

Course duration

50 minutes + 20 minutes software installation + 15 minutes (self-evaluation test)

Link to FuseGI VLE course material

https://fusegi.cs.ihu.gr/vle/course/view.php?id=6

Link to FuseGI VLE self evaluation quiz

https://fusegi.cs.ihu.gr/vle/mod/quiz/view.php?id=41

4. Georeferencing, Dizitaging and Editing tools

Course overview

The course deepen the use of QGIS software. The necessary steps to carry the georeferencing process, the creation of layers, the correction of the geometry of the GIS layers, the use of tools allowing the digitization of data as well as all the necessary exemplifications are presented.

Course structure

- Geometric correction
- Georeferencing process
- Creating layers
- Digitization
- Editor/ Attributes
- Symbology
- Practice

Level 2

Getting started

Targeted skills

- ✓ Getting started with georeferencing process
- ✓ Create Shapefile layers (polygons, lines, points) in order to digitize spatial elements (example: drilling points, crop areas).
- ✓ Getting started with the attribute table

Course duration

1hour et 20 minutes + 20 minutes software installation + 15 minutes (self-evaluation test)

Link to FuseGI VLE course material

https://fusegi.cs.ihu.gr/vle/course/view.php?id=7

Link to FuseGI VLE self-evaluation quiz

https://fusegi.cs.ihu.gr/vle/mod/quiz/view.php?id=52

5. Spatial Analysis

Course overview

The course provide a comprehensive vision of spatial analysis tools as well as spatial queries with location selection and basic statistics. The course present and precise the utility and use of buffer zones as well as other GIS layer processing tools such as union, clip and intersection tools.

Course structure

- Statial Analysis
- Spatial Analysis tools
- Basics statistics / Select by location / Statial Query
- Buffer zones
- Intersect / Union / Clip
- More

Level 2

Getting started

Targeted skills

- ✓ Processing with spatial data analysis (using different GIS softwares: QGIS, GRASS, SAGA)
- ✓ Getting started with the “buffer”, “intersection”, “union” and “clip” tools

Course duration

1hour + 20 minutes (self-evaluation test)

Link to FuseGI VLE course material

https://fusegi.cs.ihu.gr/vle/course/view.php?id=8

Link to FuseGI VLE self-evaluation quiz

https://fusegi.cs.ihu.gr/vle/mod/quiz/view.php?id=63

6. Maps and Cartography

Course overview

The course presents the basics and principles of cartography as well as the basic functions of a map and what types of information can be found in a map. The types of maps that can be represented using GIS are also presented. The design principles of cartographers are analyzed and all the associated options of the QGIS workspace are provided.

Course structure

- Principles of Cartography
- Cartography Target
- Map Layout
- Symbols & Colors
- Export
- More…

Level 2

Getting started

Targeted skills

- ✓ Creation of cartographic representation
- ✓ Customization of results

Course duration

1hour and 10 min + 20 minutes (self-evaluation test)

Link to FuseGI VLE course material

https://fusegi.cs.ihu.gr/vle/course/view.php?id=9

Link to FuseGI VLE self-evaluation quiz

https://fusegi.cs.ihu.gr/vle/mod/quiz/view.php?id=74

7. GRASS GIS

Course overview

The course introduces the basics, the possible uses and the workspace of a another software: the Grass GIS software. The course highlights the complementarity to QGIS; Grass software also uses raster and vector data and it allows the processing of images and the processing of public data. Public data repositories are presented in the course, via links, to access on the biosphere or the environment.

Course structure

- About GRASS
- GRASS Workspace
- Working with raster and vector data
- Image processing
- Public data Repositories
- More…

Level 3

Advanced use

Targeted skills

- ✓ Getting started with GRASS GIS software
- ✓ Processing raster layer data

Course duration

1hour and 10 min + 20 minutes (self-evaluation test)

Link to FuseGI VLE course material

https://fusegi.cs.ihu.gr/vle/course/view.php?id=10

Link to FuseGI VLE self-evaluation quiz

https://fusegi.cs.ihu.gr/vle/mod/quiz/view.php?id=85

8. Hydrological Analysis, QGIS tools

Course overview

The course is focused on one discipline, hydrology. Nevertheless, it is accessible to people not familiar with this field. It consists of an introduction to hydrology and a presentation of softwares used for hydrology. A description of useful tools and the procedure to follow for a hydrological analysis are presented.

Course structure

- Introduction to Hydrology
- Hydrological softwares
- Hydrological analysis – Toolboxes
- Digital Elevation Model (DEM)
- Flow direction – Catchment area
- More…

Level 3

Advanced use

Targeted skills

- ✓ Use of hydrology specific tools such as SAGA software
- ✓ Creation of DEM (Digital Elevation Model)
- ✓ Data processing to create the cartographic representation of a watershed

Course duration

1hour + 20 minutes (self-evaluation test)

Link to FuseGI VLE course material

https://fusegi.cs.ihu.gr/vle/course/view.php?id=11

Link to FuseGI VLE self-evaluation quiz

https://fusegi.cs.ihu.gr/vle/mod/quiz/view.php?id=96

9. Web Scrapping Application in QGIS

Course overview

The course is dedicated to the "web scraping", i.e. searching for information online and processing this information with online tools or with software such as QGIS. This course introduces the web scraping and the methods to search online data. After the presentation of a real life case study in the field of public health, the combination of web scraping processes and the QGIS software is analyzed.

Level 3

Advanced use

Course structure

- Web Scraping
- Export Data from the Web
- A realistic application of Web Scraping related to public Health
- Combining Web Scraping and QGIS

Targeted skills

- ✓ Acquire online data of any type
- ✓ Getting started with online tools (ex. Webscrapping, Datawrapper)

Course duration

1hour + 20 minutes (self-evaluation test)

Link to FuseGI VLE course material

https://fusegi.cs.ihu.gr/vle/course/view.php?id=12

Link to FuseGI VLE self-evaluation quiz

https://fusegi.cs.ihu.gr/vle/course/index.php?categoryid=2

3.3 Case Studies Curricula

The 4 **case studies** have a realistic and precise objective: to **reinforce** through practice the **GIS skills acquired during the courses** as well as to **develop new more technical-oriented up-to-date skills** with a focus on the FuseGI project's thematic pillars (Water, Forest and Health). Each of these case studies provides in their turn specific technical skills**.**

In the following parts the **identity card** for **each case study** is provided presenting an **overview and its objectives**, the **related courses**, the **targeted skills**, the **estimated course duration** as well as the link to the FuseGI VLE platform.

It is important to highlight that the **indicated duration** for each proposed activity (both courses of case studies) is **highly dependent on the initial level and the skills of the trainee also as the working effort and concentration**.

1. Land Use Land Cover (LULC) / Forest

Overview and objectives

The studied area is located in the island of Chios in Greece. LULC is a dynamic feature very useful to track relevant changes in land cover. This case study is aiming to map forest changes in Chios in three areas of different altitudes and how has forest changed the last 10 years in Chios. Is there gain or loss of forest and is this gain/loss dependent to elevation? The instruction for this case study is given in the form of a succession of steps to follow.

Level 3

Advanced use

Related courses

- Course 4 – Georeferencing , Scanning and Editing
- Course 5 – Spatial analysis
- Course 6 – Cartography

Targeted skills

- ✓ Process and map forest change data
- ✓ Analyze change data for sustainable system management

Duration of the activity

9 hours

Link to FuseGI VLE case study material

https://fusegi.cs.ihu.gr/vle/course/view.php?id=17

2. Hydrology case study 1

Overview and objectives

The best knowledge of the hydrographic network in a given area is of primer importance for hydrology related analyses. The change of a waterbody and the alterations of its hydromorphology can affect the natural properties of the water resource and the services that it can provide. This case study is created to test skills acquired from all the courses in a given area to assess the alteration in a lake's coastline, affecting the lake's coastal habitat zone and its land uses.

Level 3

Advanced use

Related courses

- Course 2 – Spatial Data
- Course 4 – Georeferencing , Scanning and Editing
- Course 5 – Spatial analysis
- Course 6 – Cartography
- Course 8 – Hydrological tools and QGIS

Targeted skills

- ✓ Process surface water spatiotemporal evolution
- ✓ Analyze changes related to natural and human activities

Duration of the activity

9 hours and 30 minutes

Link to FuseGI VLE case study material

https://fusegi.cs.ihu.gr/vle/course/view.php?id=16

3. Hydrology case study 2

Overview and objectives

The main question of this case study is: How to prioritize, based on physical criteria, the rivers of an area according to their sensitivity to thermal variations in the perspective of climate changes? The objective is to assess a degree of sensitivity (from low to high) to each section of rivers (WFD Surface Water Body), based on information provided by several existing databases, and to better direct the program of measurements.

Related courses

- Course 2 – Spatial Data
- Course 4 – Georeferencing , Scanning and Editing
- Course 5 – Spatial analysis
- Course 6 – Cartography
- Course 8 – Hydrological tools and QGIS

Level 2

Getting started

Targeted skills

- ✓ Effective use of the attribute table
- ✓ Analyze and classify rivers in anticipation of climate change

Duration of the activity

3 hours

Link to FuseGI VLE case study material

https://fusegi.cs.ihu.gr/vle/course/view.php?id=20

4. Health case study

Overview and objectives

The main questions of this case study are: Where and in which range of ages should the vaccination campaign be focused ? What we have learned for matching Covid vaccination data and GIS visualization of webscrapped datasets ? In this case the Brussels ministry called for the creation of a campaign for vaccination due to SARS-Cov. 2. The visualization of sensitive data (age, income, districts) and their correlation can actually support decision making.

Level 2

Getting started

Related courses

- Course 2 – Spatial Data
- Course 4 – Georeferencing , Scanning and Editing
- Course 5 – Spatial analysis
- Course 6 – Cartography
- Course 9 – Web Scraping applications and QGIS

Targeted skills

- ✓ Process spatial and attribute online population data
- ✓ Analyze and correlate sensitive data to support decision making

Duration of the activity

3 hours and 30 minutes

Link to FuseGI VLE case study material

https://fusegi.cs.ihu.gr/vle/course/view.php?id=19

4 Life-long learning program

When it comes to adult and professional education, these should have a choice selection tailored to their exact needs. When the market asks for more skills, the most usual limitation from the part of the employees is the lack of time and resources to advance their competence. So, in our part, as FuseGI consortium, we aim to further provoke their will and motivate their awareness on the series of pragmatic alternatives that exist supporting a continuing, life-long learning training. Actually, this is a recent societal tendency that we should embrace.

The life-long learning programs come to fill the existing knowledge and skill gaps that professionals have, offering the means to: professional advancing, morale satisfaction, keep-up with the altering trends and needs, information on new strategies and techniques, adaptation and evolution to confront daily needs, transfer knowledge and gain experiences among others.

As an **alternative perspective to the final curricula** and the supporting platform, we drafted a **life-long learning programme**, that if a professional wishes to advance his/her skills and does not want to attend a master course or join a self-training platform, he could follow it. In such a programme he/she could be trained in his/her own tempo, but with academic guidance on a predefined schedule (and structure) dedicating few months of effort in close collaboration with the academia and/or private institutes that can provide such services. Moreover, life-long learning programmes support synchronous and asynchronous training and come with a certification in accordance with ECTS, through novel examination approach.

LIFE-LONG LEARNING PROGRAM DESCRIPTION	
Project title	GIS application on environment, forestry and health

Project aim

The aim of the proposed program is to offer the learning of modern GIS techniques. The whole program focuses on the training of both young scientists and executives of basic background, as well as senior executives, who work in private entities and in public entities related to the management of environment, forestry and health. The main objective is also to strengthen the unemployed with new modern skills in the field of GIS applications.

Project's brief description

The program includes the presentation and analysis of contemporary GIS techniques and tools for the management of environment, forestry and health. In addition to the presentation of the basic background of this applied field, new GIS tools and techniques will be presented. In detail the program will firstly present all the necessary tools for using GIS in environmental, forestry and health management and secondly will deepen on the use of these tolls, through the presentation of several case studies.

Learning results

Knowledge:

Possesses broad, specialized, objective and theoretical knowledge in a field of work or study and is aware of the limits of that knowledge.

Skills:

Possesses a wide range of cognitive and practical skills required to find creative solutions to abstract problems.

Abilities:

Can manage and supervise in the context of a specific task or learning process, where unpredictable changes may also occur. He can review and develop both his own and other people's performance.

Program's total duration in hours	**Hours of Online distance learning**	**Hours of offline distance learning**
	96	94
Required time to complete the program in months	5 (190 hours total)	
ECTS	6	

Program courses

Courses	Description	Hours (Lecture – Extras)
1. **Introduction**		9 (6 – 3)
1.1 Basic elements of cartography -or mapping 1.2 Historic evolution (from digital cartography to geographic information systems) 1.3 Applications (https://gisgeography.com/gis-applications-uses/) 1.4 The nature of cartographic data (or spatial data)	• Different types of maps and its use • Maps' scale • Maps' symbols • Historic evolution of mapping usage and forming till digitization • Mapping techniques that are used through years • The meaning of geographic information systems • Using GIS (questions that can be answered) • Nature of cartographic data (geometry, attributes)	
2. **Cartography**		18 (10-8)
2.1 Layers– **the difference between vector and raster data** 2.2 Coordinates 2.3 Mercator projection 2.4 Working under different geodetic system EGSA 87 2.5 Data collection	• Basic spatial data: vector and grid/or raster data • Pros and cons between vector and raster data • Coordinate distortions • Earth's shape • https://www.youtube.com/watch?v=CPQZ7NcQ6YQ&ab_channel=Grafonaut • Exchange and collecting data (sources and rights of use based on ISO, European Committee of Standardization-CEN, Open Geospatial Consortium-OGC) and the European Directive INSPIRE 2007/2/EC. • Open data in EU • Digitizers (technical characteristics etc) and manual digitization (the method oh heads up digitization)-based on human eye capacity 0.2-0.25 mm etc • Precision and Resolution/Data completeness (ISO 19113)/Errors	

	• Types of vector data (DXF, GML, Shapefile, KML) , Types of raster data (GeoTIFF, img, esri grid)	
3. **Starting with GIS**		10 (5-5)
3.1 Installing GIS 3.2 Main menu 3.3 ArcCatalog 3.4 Georeferencing 3.5 Editor Toolbar	• Exploring the main toolbars • Connecting data through ArcCatalog • Creating a geodatabase>Feature Dataset>Feature Classes (name/type/domain)/Projected Systems • Insert picture>using 4 points. RMS error • Creating Shapefiles • Editor toolbar>Create features/Snapping/Insert-Delete vertexes • Table of attributes (calculate geometry)	
4. **Toolbox/Map view**		22 (10-12)
4.1 Analysis Tools 4.2 Conversion Tools 4.3 Raster to Vector 4.4 Map View	• Clip tool/Buffer zones • Insert/Output data to different types (excel, cad etc) • Insert title/scale/legend/north arrow etc	
5. **Satellite & GPS & remote sensing**		15 (10-5)
5.1 The evolution of satellite 5.2 Introduction to GPS 5.3 Remote sensing	• Historical data • How does GPS works/Navigation Systems • Exploring tools of remote sensing • Image classification techniques	
6. **Basic packs**		25 (15-10)
6.1 DEM 6.2 Hydro- 6.3 Geo- 6.4 GRASS 6.5 QuickMapServers	• Working on elevation models • Hydrological application, basin, flows, meteorological, statistcs • geospatial data management and analysis, image processing, producing graphics and maps, spatial and temporal modeling • Access to databases	
7. **Monitoring & Tracking**		13 (8-5)
7.1 link with monitoring station 7.2 attributes processing 7.3 Sampling tools	• Data storage for monitoring • How does GPS works/Navigation Systems • Data processing and statistical analyses • Cloud GIS	

7.4 Cloud 7.5 Data plotly	• python plugin for QGIS that allows the creation of D3 like plots	
8. **GIS in management**		30 (8-22)
8.1 Spatial Planning 8.2 Ecohydrology & Environmental Protection 8.3 Land cover modeling 8.4 Geology and History 8.5 Health 8.6 Economics	• Needs and skills and usual tasks • Real-life case study practices	
9. **Advanced GIS**		48 (24 – 24)
9.1 Mobile GIS 9.2 Ecosystem accounting 9.3 Google Earth engine 9.4 Plugin builder	• Advanced Apps use and/or creation for the field / for the office/ for the community	

Participants requirements				
Educational level	**Mandatory education**	**Secondary education**	**Technical education**	**University**
			X	X
Knowledge of English	**Level B2**	**Level C1**	**Level C2**	**Not required**
		X		

5 Innovation, Tangibility and Transferability

FuseGI Final Curricula is design to promote and ensure a competency-based approach for GIS learning. It is aimed at both the academic and engineering/operating communities, regardless of their entry level of knowledge but with a focus on the required skills. In contrary of the classical knowledge-based approach, this method is tailored to meet different learning abilities and can lead to more efficient trainees' outcomes. Thus, the trainees will be able, regardless their initial level and understanding in GIS, to undertake the course aiming specific required skills. This will result for universities in improved skills and employability of students and for the engineering/operating communities in updated technological skills and improved work deliverables.

Innovation

Considering the definition of innovation as "the practical implementation of ideas that result in the introduction of new goods or services or improvement in offering goods or services", the main innovation characteristics of this intellectual output "IO5 Final Curricula" are listed below:

- promote and ensure a competency-based approach to fully master up-to-date GIS tools and techniques
- bridge academic and professional needs in different key environmental and health sectors.
- cover simultaneously market skills gaps and educational/cognitive ones
- promote and endorse open education

Tangibility

IO5 produced a clearly tangible output. The tangibility of the IO5 outcome arises from the fact that it is "a result that is clear enough or definite enough to be easily seen, felt, or noticed".

Transferability

Taking into account the definition of transferability as "the degree to which the results of study can be applied in other contexts and studies", it is evident that the Final Curricula (IO5) constitutes a perfectly transferable output. Specifically:

1. As an example, and thanks to the competency-based approach, we present six different scenarios (not exhaustive) for the transferability of the Final Curricula developed by FuseGI project:

For universities:

- It can be implemented the way it is for undergraduate or master level degrees courses
- A part of it can be used regarding the specific formation's needs and the targeted skills
- It can be used as supporting extra material to the existing universities courses

For the engineering/operating community:

- As an assessment tool for new recruits
- As a GIS training tool for new recruits
- As an up to dat tool for the current working staff (either for a full GIS training or for specific skills acquisition)

2. Even though this Final Curricula is developed with focus on water, health and land use management and preservation, due to its design and adaptability, it can be fully transferred and partially adjusted with focus on other scientific or engineering disciplines regarding the targeting GIS skills.