Module name: Advanced Geoinformation Modelling

Academic year: 2019/2020  Code: ZSDA-3-0086-s  ECTS credits: 2

Faculty of: Szkoła Doktorska AGH

Field of study: Szkoła Doktorska AGH  Specialty: —

Study level: Third-cycle studies  Form and type of study: Full-time studies

Lecture language: Polski i Angielski  Profile of education: Academic (A)  Semester: 0

Course homepage: —

Responsible teacher: dr hab. inż, prof. AGH Cichociński Piotr (piotr.cichosci@agh.edu.pl)

Module summary
The student learns specialized spatial and descriptive (attribute) databases. She processes and verifies data from various sources for feeding official and other databases, connects, enriches, changes formats, controls the quality of raw data. She automates the processes of spatial data analysis and processing, including the creation and application of geoinformation models. She visualizes (also in 3D) data and results of spatial analyses, including those changing over time.

Description of learning outcomes for module

<table>
<thead>
<tr>
<th>MLO code</th>
<th>Student after module completion has the knowledge/ knows how to/is able to</th>
<th>Connections with FLO</th>
<th>Method of learning outcomes verification (form of completion)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M_K001</td>
<td>correctly identify and solve problems related to the acquisition, integration, processing and analysis of spatial data</td>
<td>SDA3A_K01</td>
<td>Execution of exercises, Execution of a project, Report, Oral answer, Test, Activity during classes</td>
</tr>
<tr>
<td>M_K002</td>
<td>maintain an ethical attitude while performing and presenting the results of assigned tasks</td>
<td>SDA3A_K03</td>
<td>Execution of exercises, Execution of a project, Report, Test, Activity during classes</td>
</tr>
<tr>
<td>M_U001</td>
<td>acquire, integrate, process and analyse data from specialised spatial and descriptive (attribute) databases and assess their quality</td>
<td>SDA3A_U07, SDA3A_U06, SDA3A_U01</td>
<td>Activity during classes, Test, Oral answer, Report, Execution of a project, Execution of exercises</td>
</tr>
<tr>
<td>M_U002</td>
<td>automate processes of spatial data analysis and processing, including the creation and application of geoinformation models</td>
<td>SDA3A_U07, SDA3A_U06, SDA3A_U01</td>
<td>Activity during classes, Test, Oral answer, Report, Execution of a project, Execution of exercises</td>
</tr>
</tbody>
</table>
visualize (also in 3D) data and results of spatial analyses, including those changing over time

Knowledge: he knows and understands

specialised spatial and descriptive (attribute) databases and their usability

methods and techniques of visualization (also in 3D) of objects and phenomena, including those changing over time

standards defining the formal basis for modelling and the description of the quality of geoinformation

methods and techniques of integration and harmonization of spatial data

advanced methods and techniques of spatial data processing and analysis, including ways of their automation

Number of hours for each form of classes

<table>
<thead>
<tr>
<th>Form of classes</th>
<th>Lectures</th>
<th>Auditorium classes</th>
<th>Laboratory classes</th>
<th>Project classes</th>
<th>Conversation seminar</th>
<th>Seminar classes</th>
<th>Practical classes</th>
<th>Fieldwork classes</th>
<th>Workshops</th>
<th>Prace kontrolne i przejściowe</th>
<th>Lektorat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suma</td>
<td>30</td>
<td>8</td>
<td>0</td>
<td>0</td>
<td>22</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

FLO matrix in relation to forms of classes

<table>
<thead>
<tr>
<th>MLO code</th>
<th>Student after module completion has the knowledge/ knows how to/is able to</th>
<th>Form of classes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Lectures</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Social competence: is able to
### Module card - Advanced Geoinformation Modelling

| M_K001 | correctly identify and solve problems related to the acquisition, integration, processing and analysis of spatial data | - | - | + | - | - | - | - | - |
| M_K002 | maintain an ethical attitude while performing and presenting the results of assigned tasks | - | - | + | - | - | - | - | - |

### Skills: he can

| M_U001 | acquire, integrate, process and analyse data from specialised spatial and descriptive (attribute) databases and assess their quality | - | - | + | - | - | - | - | - |
| M_U002 | automate processes of spatial data analysis and processing, including the creation and application of geoinformation models | - | - | + | - | - | - | - | - |
| M_U003 | visualize (also in 3D) data and results of spatial analyses, including those changing over time | - | - | + | - | - | - | - | - |

### Knowledge: he knows and understands

| M_W001 | specialised spatial and descriptive (attribute) databases and their usability | + | - | - | + | - | - | - | - |
| M_W002 | methods and techniques of visualization (also in 3D) of objects and phenomena, including those changing over time | + | - | - | + | - | - | - | - |
| M_W003 | standards defining the formal basis for modelling and the description of the quality of geoinformation | + | - | - | + | - | - | - | - |
| M_W004 | methods and techniques of integration and harmonization of spatial data | + | - | - | + | - | - | - | - |
| M_W005 | advanced methods and techniques of spatial data processing and analysis, including ways of their automation | + | - | - | + | - | - | - | - |
Student workload (ECTS credits balance)

<table>
<thead>
<tr>
<th>Student activity form</th>
<th>Student workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>Udział w zajęciach dydaktycznych/praktyka</td>
<td>30 h</td>
</tr>
<tr>
<td>Preparation for classes</td>
<td>6 h</td>
</tr>
<tr>
<td>przygotowanie projektu, prezentacji, pracy pisemnej, sprawozdania</td>
<td>6 h</td>
</tr>
<tr>
<td>Realization of independently performed tasks</td>
<td>6 h</td>
</tr>
<tr>
<td>Contact hours</td>
<td>2 h</td>
</tr>
<tr>
<td>Summary student workload</td>
<td>50 h</td>
</tr>
<tr>
<td>Module ECTS credits</td>
<td>2 ECTS</td>
</tr>
</tbody>
</table>

Additional information

Module content

Lectures

Standardization in the area of geographic information

Harmonization and exchange of spatial data
Basic concepts. Harmonization in the INSPIRE directive and in the act on spatial data infrastructure. Components of spatial data harmonization. Additional aspects of harmonization. Planning for harmonization. Searching for the optimal level of harmonization. Stages of harmonization. Spatial data exchange rules and standards (including GML, KML, GeoJSON). New business models: processing and verification of data from various sources in order to integrate them into official and other databases, combining, enrichment, changing formats, quality control of raw data.

Integration of spatial and non-spatial data
Censuses and other statistical data, spatial statistics. Table Joining Service (TJS) standard. Geocoding: definition, construction of an address locator, alias table, geocoding process, characteristics of possible errors and possibilities of their correction. Methods of visualizing three-dimensional data: extrusion of objects by a height value, 3D symbols. Animations of spatial data, including time-varying. The specificity of large, variable and diverse data sets (big data).

Metadata and quality of spatial data

Spatially enabled society (SES)
Information society. The needs of societies in the field of spatial information. The role and tasks of real estate management: cadastre and land registry, real estate appraisal, spatial planning. Essential elements enabling the implementation of the SES
vision: legal basis, integration of data from various sources, infrastructure allowing for precise location, spatial data infrastructure, information about land ownership, the possibility of free re-use of data.

**Project classes**

*Visualization of three-dimensional and time-varying data*
Extrusion of objects by a height value, 3D symbols. Ways of creating animations for previously prepared visualization. Creating animation of the time layer, playing the animation, creating animations of data presented in the chart.

*Automation in geographic information systems*
Creating one’s own tools: adding a toolbox, adding, editing, setting parameters and running the script. Building the analysis model, determining the model parameters, launching the model from the dialog.

*Exchange and harmonization of spatial data*
Automation of the process of changing data structures, their harmonization and integration in spatial data warehouses. Understanding mechanisms that enable combining data from different sources, stored in different formats and coordinate systems into one coherent data set. The use of ETL tools. Processing of large, variable and diverse data sets (big data).

**Individual project**
Individual formulation of the problem and implementation of a complex GIS project including the acquisition, evaluation and harmonization of data, carrying out selected spatial analyses using data processing automation methods and the presentation of results.

**Teaching methods and techniques:**
Lectures: The content presented at the lecture is communicated in the form of a multimedia presentation in combination with a classic blackboard lecture enriched with demonstrations related to the presented topics.
Project classes: Students prepare the project on their own, without much intervention of the teacher. This is to develop a sense of responsibility for teamwork and responsibility for decisions made.

**Warunki i sposób zaliczenia poszczególnych form zajęć, w tym zasady zaliczeń poprawkowych, a także warunki dopuszczenia do egzaminu:**
1. Active participation and positive results of current checking whether the assumed learning outcomes have been achieved by the student are the basis for passing the course.
2. Participation in classes is obligatory. A maximum of two unexcused absences per semester is allowed. A justification for absence may be health reasons (confirmed by medical exemption) or other important reasons recognized by the person conducting the exercise. The student is obliged to justify absence at the first class after the cause of absence has ceased. Exceeding the threshold of 20% of unexcused absences results in the lack of the possibility to pass the course.
3. In exceptional cases, a student who has exceeded the above-mentioned limits for important random reasons or because of a documented long-term illness may obtain the teacher’s consent to pass the course.
4. The program of the course includes 5-6 exercises (or 2-3 projects) and 1-2 tests every semester. All topics / projects and tests must be passed.
5. The ongoing control of learning outcomes is based on: checking exercises / projects systematically submitted by students (on a computer screen or in the form of a write-up), verifying the knowledge of issues covered by a given exercises (a student may be asked to explain / present how to implement the task), conducting practical test at the computer and written tests of theoretical knowledge.
6. Student can become acquainted with detailed results of the evaluation of written work (exercises,
projects, tests) only in person at the teacher.
7. The student should keep files created as a result of the implementation of exercises / projects until
passing the course.
8. Detected lack of independence of the student’s work or use of unauthorized materials results in
failing grade (2.0) in the nearest term of passing. In addition, detected cases of plagiarism will be
reported to the dean’s authorities.
9. The possibility of using auxiliary materials is determined by the teacher for each test. During tests it
is forbidden to use devices that allow the registration, storage and playback of texts or images, in
particular mobile phones.
10. An unexcused absence from the test results in obtaining “nb”.
11. The student is obliged to correct the test, from which she obtained a failing grade (2.0). It is not
possible to correct positively passed test.
12. Passing the course is made on the basis of control of learning outcomes during the semester and
should be made no later than on the last day of the semester in which the classes are conducted
(Deadline 1). The grade is a weighted average of the grades from tests (weight 0.6) and grades for
completed exercises / projects (weight 0.4). Failure to pass the course within the prescribed period
results in obtaining the failing grade (2.0). Two additional deadlines are set: Deadline 2 – until the end
of the basic session, Deadline 3 – until the end of the re-sit session.

Zasady udziału w poszczególnych zajęciach, ze wskazaniem, czy obecność studenta na zajęciach jest obowiązkowa:
Lectures:
- Attendance is mandatory: No
- Participation rules in classes: Students participate in classes learning new content according to the
syllabus of the course. Students should ask questions and clarify doubts on an ongoing basis.
Audiovisual registration of a lecture requires the consent of the lecturer.
Project classes:
- Attendance is mandatory: Yes
- Participation rules in classes: Students carry out practical work in order to acquire the competences
assumed by the syllabus. The way the project is carried out and the final result are evaluated.

Method of calculating the final grade
FG = P
where:
P – grade from project classes (arithmetic mean of all deadlines; if the grade of at least one deadline is
positive, then P>=3.0)

Sposób i tryb wyrównywania zaległości powstałych wskutek nieobecności studenta na zajęciach:
Compensation of backlogs resulting from the student’s absence from the classes consists in
participation in classes with another group (as far as free computers are available) or through the
individual implementation of the tasks to be performed on these classes.

Prerequisites and additional requirements
Basic knowledge of geographic information systems (GIS). Basic knowledge of English.

Recommended literature and teaching resources
1. Bielecka E. Systemy informacji geograficznej. Teoria i zastosowania. Wydawnictwo PJWSTK,
Warszawa 2006.
2. Eckes K. Modele i analizy w systemach informacji przestrzennej. AGH Uczelniane Wydawnictwa
Naukowo-Dydaktyczne, Kraków 2006.
3. Future Trends in geospatial information management: the five to ten year vision, Second Edition
4. Handbook on Geospatial Infrastructure in Support of Census Activities, United Nations Publications,
Sales No. E.09.XVIII.8, 2009.
6. Litwin L., Myrda G. Systemy informacji geograficznej : zarządzanie danymi przestrzennymi w GIS,
Scientific publications of module course instructors related to the topic of the module


14. Cichociński P.: Porównanie metod interpolacji przestrzennej w odniesieniu do wartości nieruchomości (Comparison of spatial interpolation methods for real estate values). Studia i Materiały
Towarzystwa Naukowego Nieruchomości 2011, vol. 19, nr 3, s. 120–132.

Additional information
1. Information, announcements, results of tests, as well as auxiliary materials for classes are posted on the course website placed on the University e-Learning Platform (https://upel.agh.edu.pl/wggiiis). The password for access to the course is provided by the lecturer at the first class. Publication of information on this site is considered to be made available to students.
2. Individual consultations, held on dates announced at the beginning of each semester are supplementary to all forms of classes.
3. Classes are held at the Computer Laboratory of the Department of Mining Surveying and Environmental Engineering. The student is required to know and comply with the rules and regulations in force on the website http://pk.geod.agh.edu.pl.