TARAS SHEVCHENKO NATIONAL UNIVERSITY OF KYIV

INSTITUTE OF GEOLOGY

Department: **Geoinformatics**

«APPROVED»
Deputy Director on academic work
_____
«31» 08 2021

WORK PROGRAMME OF THE DISCIPLINE
Big Data in Geosciences
(Великі дані у геонауках)

for student

Branch of knowledge	*19 Architecture and Construction*
Training direction (Specialty)	*193 Geodesy and Land management*
Educational level	*master*
Educational programs	*Evaluation of land and real estate*
Type of discipline	*Obligatory*

Teaching mode	*full-time studies*
Academic year	*2021/2022*
Semester	*2*
Number of credits ECTS	*3*
Language of teaching, learning and evaluation	*English, Ukrainian*
Form of final control	*modular test*

Lecturers: *Virshylo Ivan Viktorovych, PhD in Geology, Associate professor, Department of Geoinformatics.*

To be continued

for 2022/2023 _____ 20__

Kyiv - 2021

Author(s): *Virshylo Ivan Viktorovych, PhD in Geology, Associate professor, Department of Geoinformatics*

APPROVED
17 05 2021
Head of department of Geoinformatics
_____ (Vitalii Zatserkovnyi.)

Protocol №11 dated 17/05/2021

Approved by Scientific-methodical Commission of Institute of Geology

Protocol №1 dated 31/08 2021
Head of the scientific methodical commission _____ (Demidov V.K.)

The aim of the discipline - is to familiarize students with the basic modern views on the concept of big data and supported processing methods such as data mining. The subject of study is the overview of existing big data examples in geosciences, including data sources, data acquiring methods and data storages.

Preliminary requirements:

1. Basic knowledge of general disciplines of Earth sciences (geology, geophysics, geodesy, etc.), basic of databases and programming.
2. Basic technical skills in informational technologies, programming, data processing and databases.
3. The level of English proficiency at least B1.

Annotation of discipline:

Academic discipline "Big data in Geosciences" that integrates the knowledge of geodata in Earth sciences is part of education and sciences training program for the education level "master" of specialty 193- Geodesy Land surveying , educational program: Valuation of land and property. This discipline is obligatory discipline for educational program " Valuation of land and property ".

The discipline is taught in the 2nd semester of 1st year Master's degree program in volume - 90 hours (3 credits ECTS) including lectures - 14 hours, practical works - 14 hours, consultations - 2 hours, self-study work - 60 hours. The course content provides two modules and two module tests. The discipline is finished by test.

The tasks of the discipline – to highlight the following issues:

- big data concept;
- geodata sources and techniques of the data acquiring;
- geodatabases and data warehouses;
- geodata processing methods;
- applications of big data in the geosciences.

The results of study:

Learning results (1. to know; 2. be able to; 3. communication; 4. autonomy and responsibility)		*Methods of teaching and learning*	*Assessment methods*	*Percentage in the final assessment of the discipline*
1.1	Big data concept, terms and definitions	*Lecture*	Paperwork	*up to 5%*
1.2	Sources of big data existing in different geosciences	*Lecture*	Paperwork	*up to 5%*
1.3	Data models, modern geodatabases structures and existing database software	*Lecture, practical works*	Paperwork	*up to 10%*
1.4	Methods for geodata processing: geostatistics, online analytical processing and data mining	*Lecture, practical works*	Paperwork	*up to 10%*
1.5	Big data applications in geology and geophysics	*Lecture practical works*	Paperwork	*up to 10%*
1.6	Big data applications in other geosciences	*Lecture, practical works*	Paperwork	*up to10%*
2.1	Create big geodatasets in databases and data warehouses	*Lecture, practical works*	Paperwork	*up to 15%*
2.2	Apply methods of geostatistics for big data	*lecture*	Paperwork	*up to 10%*
2.3	Provide spatial analysis of big data using dedicated software;	*lecture*	Paperwork	*up to 5%*

Learning results (1. to know; 2. be able to; 3. communication; 4. autonomy and responsibility)		*Methods of teaching and learning*	*Assessment methods*	*Percentage in the final assessment of the discipline*
3.1	Ability to communicate in a foreign language (English).	*practical works*	Paperwork	*up to 15%*
4.1	Ability to work in an international context and in a global information environment by specialty.	*practical works*	Paperwork	*up to 5%*

Relationship between the discipline's and Programme's study results

Discipline study results / **Programme study results**	**1.1**	**1.2**	**1.3**	**1.4**	**1.5**	**1.6**	**2.1**	**2.2**	**2.3**	**3.1**	**4.1**
PSR 1. Use the technical Ukrainian language orally and in writing and be able to communicate in a foreign language (English) in the circle of geodesy and land management specialists.	+	+			+			+	+	+	+
PSR 3. Know the regulatory and legal principles of ensuring rational use, protection, accounting and assessment of land at the national, regional, local and economic levels, procedures for state registration of land plots, other real estate objects and restrictions on their use.	+	+	+	+	+	+	+	+	+		+

Structure of discipline: lectures, practical works, self-studying work of student

Scheme of grading forms:

Form of student evaluation:

- semester grading:

1. First Control test - (min - 6, max - 10 grades)
2. Second Control test - (min - 6, max - 10 grades)
3. Works paper and oral reports (min - 32, max - 60 grades)

- final assessment (modular test) in form of the written test (min - 12 , max - 20 grades)

Final evaluation is in the form of a final test (total score of discipline (maximum 100 grades) is defined as the sum for the systematic work during the semester).

Final evaluation based on the results of the student's work throughout the semester.
Procedure and evaluation system

	Semesters grades	**Modular test**	**Final grade**
Min	*48*	*12*	*60*
Max	**80**	**20**	**100**

For students who have obtained total grades less than critically-calculated minimum of 20 grades repeated control test is obligatory for taking the test. The modular test can not be less than 12 grades in order to obtain a general positive assessment for the course.

Grading: For admission to the final grading it is obligatory: 1) to pass two control tests; 2) to prepare six oral reports, which can be presented in the form of presentations and abstracts. The final grading is carried out in the form of written modular test.

Assessment:

Conformity scale

Passed	60-100
Fail	0-59

STRUCTURE OF THE DISCIPLINE

PLAN OF LECTURES AND SEMINARS

#	Theme	Hours		
		Lectures	**Practical works**	**Self – studying work**
Module 1 Big Data in geosciences				
1	**Theme 1.** Introduction to big data	2		10
2	**Theme 2.** Sources of big data in geology and geophysics.	2	2	10
3	**Theme 3.** Databases applications for big data in geosciences**.**	2	2	10
4	*Test 1*		2	
Module 2. Big geodata processing methods				
5	**Theme 4.** Geostatistics	4	2	10
6	**Theme 5.** Elements of Online analytical processing and data mining	2	2	10
7	**Theme 6.** Big data applications in geosciences.	2	2	10
8	Test 2		*2*	
9	***Modular test***			2
	Total	**14**	**14**	**60**

Themes for self-studying work:

1.Big data terms and definitions.
2. Data acquiring techniques in geosciences.
3.Databases and data warehouses applications and software.
4.Methods of geostatistical analysis.
5.OLAP and Data mining concepts.
6.Application of big data in geophysics, geology, geodesy, topography, oceanology, .

Total hours of the discipline – *120, that include:*

lectures **– 14** *hrs*
practical classes - **14** *hrs*
consultations - **2** *hrs*
self-studying work **- 60** *hrs*

RECOMMENDED LITERATURE

Basic:

1. Cebr: Data equity, Unlocking the value of big data. in: SAS Reports, pp. 1–44 (2012)
2. EMC: Data Science and Big Data Analytics. In: EMC Education Services, pp. 1–508 (2012)
3. Manyika, J., Chui, M., Brown, B., Bughin, J., Dobbs, R., Roxburgh, C., Byers, A.H.: Big Data: The Next Frontier for Innovation, Competition, and Productivity. In: McKinsey Global Institute Reports, pp. 1–156 (2011)
4. Plattner, H., Zeier, A.: In-Memory Data Management: An Inflection Point for Enterprise Applications. Springer, Heidelberg (2011)
5. Russom, P.: Big Data Analytics. In: TDWI Best Practices Report, pp. 1–40 (2011)
6. Big Data: Survey, Technologies, Opportunities, and Challenges http://www.hindawi.com/journals/tswj/2014/712826/
7. "Challenges and Opportunities with Big Data", A community white paper developed by leading researchers across the United States.
8. C. Wunsch, Discrete Inverse and State Estimation Problems With Geophysical Fluid Applications. 371 pp: Cambridge University Press, 2006.
9. V. Mithal, G. Nayak, A. Khandelwal, V. Kumar, N. C. Oza, and R. Nemani, "Rapt: Rare class prediction in absence of true labels," IEEE Transactions on Knowledge and Data Engineering, 2017.
10. Villars, R.L.; Olofson, C.W.; Eastwood, M. *Big Data: What It Is and Why You Should Care*; IDC: Framingham, MA, USA, 2011.
11. Federal Geographic Data Committee. Emerging Technologies and the Geospatial Landscape. A Report of the National Geospatial Advisory Committee. Available online: https://www.fgdc.gov/ngac/meetings/dec-2016/ngac-paper-emerging-technologies-and-the.pdf

Additional:

1. NSF Expeditions in Computing, "Understanding Climate Change: A data-driven Approach," http://climatechange.cs. umn.edu/, 2017.
2. American Geophysical Union, "Earth & Space Sciences Informatics," http://essi.agu.org/, 2017.
3. NSF-funded Research Collaboration Network, "Intelligent Systems for Geosciences," https://is-geo.org/, 2017.
4. U.S. Geological Survey, "Land Processes Distributed Active Archive Center," https://lpdaac.usgs.gov/, 2017
5. National Oceanic and Atmospheric Administration, "National Centers for Environmental Information," https://www.ncdc. noaa.gov/, 2017
6. An Introduction to the World's Oceans, Seventh edition. McGraw-Hill Higher education. New York. 2003. - 521 p.