Methods of Identifying the Correlation of Ukrainian Scientific Paradigms Based on the Study of Defended Dissertations

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Abstract

The paper examines the concept of scientific space and the peculiarities of its formation in Ukraine. The structure of information on defended dissertations is studied. The author introduces heuristics that, firstly, contribute to structuring the available poorly structured information, secondly, supplement the information that is not enough to formalise the problem with known mathematical models, and thirdly, declare the authors' position a priori, outline the outline of further presentation of the material and the limitations on research that the authors limit themselves to. The article presents approaches to the analysis of dissertations defended in Ukraine in 1993-2020. The parameters of defended dissertations, the values of which are available in open access databases, are listed and assigned identifiers. An analysis of Ukrainian cities in which a large number of dissertations were completed and defended is carried out. Such cities are defined as scientific centres. A matrix of statistics on the relationship between scientific organisations in Ukrainian cities is constructed. An illustration of the relationships between Ukrainian cities is provided and the scheme of these relationships is displayed on the map of Ukraine. Thus, the preliminary structuring of the scientific space in terms of the preparation and defence of dissertations was carried out. Models are developed and directions for further research of the scientific space of Ukraine are identified. It is proposed to identify keywords in the abstracts of dissertations based on text analysis and to identify areas of research by analysing the degree of similarity between sets of keywords related to dissertations.

Keywords [1]

Scientific space, weakly structured system, heuristics, dissertation, adjacency matrix, research centres, research topics, formalisation

1. Introduction

Scientific activity has a long history and has always been one of the fundamental axes of social development [1, 2]. From the first attempts to understand nature and society to today's huge scientific projects, science has constantly tried to expand the horizons of knowledge and understanding.

Today, science is characterised by rapid development and constant change. Society follows the new discoveries, ideas and technological innovations that are born from scientific research. This constant development of science, however, is inextricably linked to the concept of scientific paradigms [3, 4].

Scientific paradigms are the fundamental concepts, theories, methods and approaches that define the way we understand and explore the world around us. They influence what questions are investigated, what experiments are performed, and how information is interpreted. Changes in scientific paradigms can overturn the existing picture of the world, opening up new opportunities for research and development [5, 6].

The shift in scientific paradigms is not just an evolution of science, but a true revolution that transforms the way we understand the world. This revolution affects every scientist, researcher, engineer

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and consumer of scientific information. Understanding this impact is an important task for the scientific community and society as a whole. In this article, we will look at this task in more detail and detail.

2. The urgency of the problem

The study of the impact of changing scientific paradigms on the scientific space is extremely relevant in the modern world, as the scientific community and society as a whole face a number of significant challenges and questions that require answers.

1. Scientific Progress and Innovation: Modern science is the engine of technological and innovative progress. Changes in scientific paradigms can open up new opportunities for the development and improvement of technologies that affect all areas of life.

2. Globalisation of Science: Science is becoming increasingly global, with scientists from different countries collaborating and sharing knowledge. Understanding the impact of scientific paradigms on the global scientific space can improve cooperation and mutual understanding.

3. Interdisciplinarity: The boundaries between different branches of science are becoming less and less sharp. Shifting scientific paradigms can foster an interdisciplinary approach that allows complex problems to be addressed from multiple perspectives.

4. Public Role of Science: Society is increasingly looking to science to address important issues, from climate change to health to economic issues. Understanding the impact of scientific paradigms on such societal challenges helps to direct scientific potential in the right direction.

5. The Future of Education: Shifting scientific paradigms are affecting how young people learn and what skills and knowledge are becoming important. Understanding this impact is important for the development of education systems [7].

6. The role of Ukrainian science: Ukraine, like other countries, faces the challenges of the globalised scientific space. Understanding the impact of changing scientific paradigms on Ukrainian science and the scientific space is important for the country's development in the context of the global scientific community [8, 9].

This article aims to explore the impact of scientific paradigms on the scientific space from different perspectives and help us better understand how these changes affect our scientific community and society as a whole. By analysing this impact, we can better adapt our actions and decisions to the requirements of the modern world and contribute to further scientific development.

3. Purpose and objectives of the study

The purpose of this article is to study the impact of scientific paradigms on the modern scientific space and to reveal its main characteristics. Formalising these characteristics will help to improve the structure of the scientific space and understand the interaction between scientific paradigms and the scientific community.

Objectives: The following objectives have been identified to achieve the above goal:

- Identification of Research Centres: The study aims to identify the main centres, cities that play a key role in research and thesis defence.
- Analysis of the Frequency of Dissertation Completion and Defence: This task involves determining how often dissertations are completed and defended in different cities and organisations.
- Determination of Links and Networks between Cities: The study should include an analysis of the links and interactions between cities as defined by scientific cooperation.
- Visualisation of the Geography of Scientific Research: To better understand the geography of the research space, the study will include visualisation of the location of cities and organisations where theses were conducted.
- Research on the Impact of Changing Scientific Paradigms: The study examines the relationship between the change of scientific paradigms and the development of the scientific space, as well as the impact of these changes on the structure and functioning of the scientific community.
- Analysis of Interdisciplinary Relations: The study assesses the interrelationships between different fields of science and the impact of scientific paradigms on the development of interdisciplinary research.

4. Status of the problem development

The current stage of development of human civilisation, defined as the transition to a knowledge society, is characterised by qualitatively new requirements for the development of science. During the years of independence, more than 130 thousand PhD and more than 20 thousand doctoral dissertations have been defended in Ukraine [10, 11]. It can be confidently stated that dissertations are elements of the scientific space (SS). At the same time, the SCS is a structural element of the social space and can be considered as a complex, poorly structured system. The NP reflects the interaction of objects related to science. Streamlining this interaction, structuring different areas of the NP will contribute to a better understanding of it, increase its manageability and progressive development.

Today, researchers do not have an unambiguous and adequate understanding of the NP, which is part of the social space, along with religious, legal, moral, aesthetic, and philosophical spaces. The parameters of the NP fix the place, direction, depth and extent of the activities of social actors aimed at the scientific development of the environment [12]. In general, the concept of "scientific space" expresses the place of science in culture, outlines and localises its properties as a specific field.

Since NP is a complex multidimensional phenomenon, it is impossible to give a single definition of this concept, and therefore there are several definitions of NP [13]. It is customary to distinguish between different aspects of the concept of NP [14]: nominal, semantic, syntactic, pragmatic.

There are different approaches to the study of NPs [15, 16]. For example, by analysing research collaboration networks [17; 18]. Academic degrees and academic titles serve not only to motivate researchers and research and teaching staff, but also to structure individual components of the SP. Some tasks of studying the research activities of subjects and objects of the NP are considered in [19-21]. In the modern world, in the context of globalisation, Ukrainian scientists are obliged to be integrated into a single information scientific space. Ukrainian science, despite all the losses and problems, has retained the ability to carry out world-class research in a number of relevant areas.

The study of NPs is relevant, in particular, because today the trend towards further differentiation of scientific knowledge continues. At the same time, the boundaries of interaction between scientists are expanding, and the boundaries between different branches of science are increasingly blurred [22, 23].

5. Information support for the study

5.1. Source of data for the study

The structure of the Ukrainian scientific space was modelled on the basis of open data [24] on the defence of dissertations by Ukrainian scientists in the period from 1999 to 2023 for the group of specialities 05.13.00 - 05.13.22. The obtained fragment of data on thesis defence contained about 4000 records.

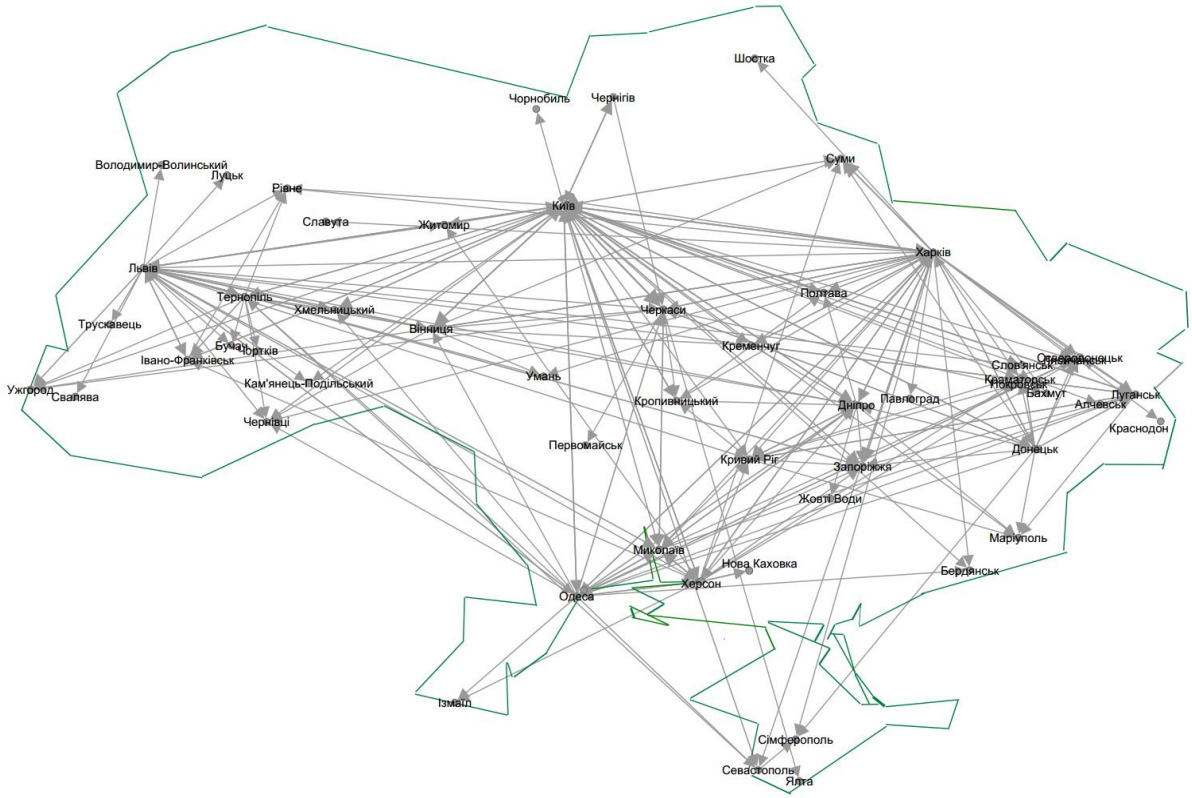
5.2. Preliminary research results

At the preliminary stage of data analysis, a 60x60 adjacency matrix was constructed, where the diagonal corresponds to theses completed and defended in the same city. It is convenient to visualise the contents of the adjacency matrix in two graphs (Fig. 1 and Fig. 2), which demonstrate the geographical location of research centres and the scientific relationships between scientific institutions in Ukrainian cities.

6. Structure of information on defended dissertations

Based on statistical studies and comparative analysis of dissertations, conclusions can be drawn about the structure of the NP of Ukraine [25]. Heuristic E1. Dissertations and the fact of their defence sufficiently reflect the level of scientific research and can be used to structure the NP. It should be noted that the dissertation is a concentrated, well-structured and sufficiently formalised information on the results of scientific research. According to official data [10, 11], from 1993 to 2023, more than 130,000 PhD and more than 20,000 doctoral dissertations were defended in Ukraine, and information on the main attributes of these dissertations is freely available. Heuristic E2. The cities where a

significant number of dissertations were written or defended are the leaders in scientific research in Ukraine.



Figbre 1. Geography of Ukrainian cities where theses were defended (excluding when the work was completed and defended)

Figure 2. Geography of Ukrainian cities in which theses were written and defended in the same city

There are parameters of the database that contains basic information about theses of Ukrainian scientists obtained from open sources: Registration number, Date of registration, Title of the thesis,

Abstract, Surname, name, patronymic of the author, Name of the group of sciences and academic degree, Speciality, Field of science and academic degree, Organisation_1, where the thesis was defended, Ministry, to which Organisation_1 belongs, Organisation_2 in which the thesis was defended, Ministry to which Organisation_2 belongs, Organisation_3 in which the thesis was defended, Ministry to which Organisation_3 belongs, Specifics of speciality, UDC, UDC refinement, Date_1, Date_2.

The content of the database is sufficient and can be used as a basis for analysis in this area of research. Based on the analysis of the cities where theses were defended, measures can be planned to strengthen cooperation between different regions of Ukraine, coordinate the activities of research centres, promote interaction between branches of science, etc.

For further analysis, we will use the following parameters $a_i, i \in I$, the values of which are available in open access databases:

a_1 – Title of the thesis;

a_2 – Abstract;

a_3 – Surname, first name, patronymic of the author;

a_4 – Name of the group of sciences and academic degree;

a_5 – Speciality;

a_6 – Field of study and academic degree;

a_7 – Organisation_1, where the thesis was completed;

a_8 – The Ministry to which Organisation_1 is subordinated;

a_9 – Organisation_2, where the thesis was defended;

a_{10} – Ministry to which the Organisation is subordinated_2;

a_{11} – Organisation_3, where the thesis was defended;

a_{12} – Ministry to which the Organisation is subordinated_3;

a_{13} – Specifying the specialty;

a_{14} – UDC;

a_{15} – Clarification of the UDC;

a_{16} – Date of thesis defence.

7. Modelling interconnections between Ukrainian research centres

Heuristic E3. The organisations where several dozen dissertations were completed or defended are scientific centres of Ukraine.

Let the set n of elements $A = \{a_1,...,a_n\}$ be given. At this stage of research, the elements of the set A are the cities of Ukraine where theses were written and defended. For further research, we will introduce sets whose elements will be used to quantify the structuring of NPs:

S^1 – a set of interconnections between cities related to the defence of dissertations;

S^2 – is the set of all existing relationships between organisations that are related to thesis defence;

S^3 – clusters of research centres;

S^4 – Dissertation defence centres by speciality;

S^5 – the number of dissertations available in the database.

For an in-depth study, we will use the following metrics:

- the sum of inputs and outputs;
- sum of facts - without specifying the number of arcs and cycles;
- number of arcs;
- number of cycles.

From the above definitions, it is obvious that the set S^2 of relationships between organisations is a subset of the set S^1 of relationships between cities related to thesis defence. We will model the structure of Ukraine's NPs as a weighted graph. The vertices of the graph are the cities of Ukraine. The output vertex is the city in which the thesis was written, and the input vertex is the city in which

the thesis was defended. Let us construct a matrix of statistics of dissertation defences $B^1 = (b_{ij}^1)$, whose elements are generated according to the following rules:

$$b_{ij}^1 = \begin{cases} \text{- is the sum of such } i \text{ for which there exists a path from vertex } a_i \text{ to vertex } a_j; \\ \text{- is the sum of the minus signs of such } i \text{ for which there exists a path} \\ \quad \text{from vertex } a_j \text{ to vertex } a_i; \\ \text{- 0 if the path from vertex } a_i \text{ to vertex } a_j \text{ does not exist (omit zero values)} \end{cases}$$

$a_i \in A^1$ - is the set of cities in which the theses were defended; $a_j \in A^2$ - is the set of cities in which theses were defended.

$A^1 \cup A^2 = A$, $A^1 \cap A^2 \neq \varnothing$.

To illustrate, we present a matrix of statistics on the relationship between cities, which was obtained on the basis of an analysis of real (open) data [24] on the defence of dissertations by Ukrainian scientists in the speciality 05.13.06 "information technology". Based on this information, we will also build a graph showing the geographical location of research centres and scientific relationships between scientific institutions in Ukrainian cities. On the basis of the matrix of statistics on the relationship between scientific organisations in Ukrainian cities, we will build an adjacency matrix. A graph showing the connections between the cities of Ukraine where theses were defended and defended and illustrating the statistics of interconnections between cities is shown in Fig. 3.

7.1. Some aspects of researching relationships

In order to structure the NP, the following aspects of interrelationships should be investigated:

- between the organisations where the thesis was completed and the organisations where it was defended;
- between dissertators, opponents, supervisors or consultants;
- based on the analysis of the keywords in the thesis.

Thus, the object of the study is a set of dissertations defended in Ukraine from 1993 to 2023. And to determine the relationships between the objects and additional structuring, NPs can be used:

- measures of similarity between objects;
- keyword ranking tasks;
- an estimate of the weighting vectors calculated on the basis of absolute values.

7.2. Modelling the research of dissertation topics

Heuristic E4. The titles of dissertations and keywords sufficiently reflect the subject matter of dissertation research and can be used to structure the NP.

It is advisable to conduct a study of dissertation topics, determine the degree of similarity in dissertation titles, word statistics, etc. To do this, we will focus on a specific speciality, for example, $a_5 =$ "Computer Science". We will consider the following subsets:

S^{51} – scientific supervisors / scientific consultants; S^{52} – scientific opponents; S^{53} – annotations; S^{54} – Keywords.

7.1. Processing natural language information in research of scientific space

To further develop the research, let us consider one aspect of scientific interconnections. For an in-depth study of the scientific space of Ukraine, in addition to, for example, a_3 – "Author's name, surname, patronymic", additional information may be used, in particular:

a_{17} – Surname, name, patronymic of the supervisor/consultant;

a_{18} – keywords in the titles of dissertations;

a_{19} – keywords by annotations;

a_{20} – UDC analysis.

	Алчевськ	Бахмут	Бердянськ	Вінниця	Дніпро	Донецьк	Житомир	Запоріжжя	Івано-Франкі	Ізмаїл	Кам'янське	Київ	Краматорськ	Сорокине (Краснодон)	Кременчуг	Кривий ріг	Крим	Кропивницки	Луганськ	Луцьк	Львів	Маріуполь	Миколаїв	Одеса	Полтава	Польща	Рівно	Севєродонец	Слов'янськ	Суми	Тернопіль	Ужгород	Харків	Херсон	Хмельницьки	Черкаси	Чернівці	Чернігів	Чорткв
Алчевськ																																		1					
Бахмут																																				2			
Бердянськ												1												1									1						
Вінниця				30								8																			2					1			
Дніпро				1	22							8																						2					
Донецьк						30						2											1	1									5			1			
Житомир																																		1					
Запоріжжя																								1									2	5					
Івано-Франківськ												3																			1			1					
Ізмаїл																								2										1					
Кам'янське															1																								
Київ				-5		-1						376							1		2		1	2							1		13	10		9		1	
Краматорськ																																		1					
Сорокине (Краснодон)																																	1						
Кременчук				-1											11																		4						
Кривий ріг					-1							-1									1		2											1					
Крим												-3					6							2									3			1			
Кропивницкий												-5																					7			2			
Луганськ						-5						-4			-2				2				1																	
Луцьк												-3												2															
Львів												-23									38			1							1								
Маріуполь						-2						-1							-1																				
Миколаїв					-2							-3									-1		4	1										6					
Одеса												-3												83									1	3					
Полтава					-1							-2																						5						
Польща																					-1																		
Рівно												-1																											
Севєродонецьк						-3																											1	2					
Слов'янськ						-3																																	
Суми				-2								-2																					10	1					
Тернопіль												-2																			11								
Ужгород												-5									-1										-1					1			
Харків												-1			-3																		292	6		2			
Херсон												-3												-1									-2	75					
Хмельницький												-9									-3										-5								
Черкаси												-14																					-2			24		2	
Чернівці												-2									-1												-1						
Чернігів												-5																										8	
Чорткв																															-1								

Figure 3. Matrix of interrelations between scientific organisations of Ukrainian cities (zero values of elements are omitted)

In order to fill the database with additional information, a new study should be conducted and the information missing from other sources should be entered.

Textual data is an attribute of our civilisation: we see it when we read books, newspapers, other printed materials, search for information on the Internet, use Facebook and Twitter, communicate with each other on various forums, etc. [26, 27]. The amount of this data is growing exponentially. Moreover, approximately 80% of text data is unstructured text. These are Wikipedia articles, web pages, blogs, emails, social media posts, e-books, etc. It is impossible to read and process all of this textual data, and in order to extract the most useful information from it, it needs to be structured, ordered, systematised, etc. Thus, there is a need for tools that help people process unstructured texts more efficiently. Therefore, the involvement of computers in solving such tasks is quite a natural phenomenon [28].

The ability of computers to perform useful tasks related to human (natural) language, to perform high-quality text or speech processing, to assist in communication between people who speak different languages, and, in general, the ability to communicate between humans and machines - all these problems are being solved by Natural Language Processing (NLP). Today, the main areas of application include information retrieval, information extraction, machine translation, question and answer systems, dialogue systems, speech recognition, natural language generation, and text tone analysis [29, 30].

The main components of the methodology for applying natural language information processing in research on scientific space can be developed and implemented in several directions.

1. Monitoring of existing measures of similarity between texts and development of new measures of similarity if necessary.

2. Generate text annotations using different approaches and determine the similarity measures between the generated annotations in order to identify the tools that best generate text annotations in the selected field of knowledge.

3. Generation of abstracts of theses defended in Ukraine since 1991.

4. Identification of research areas based on the analysis of abstracts of dissertations.

5. Clustering of research areas based on the automatic identification of these areas by abstracts of dissertations.

6. Generating annotations of dissertations that are in the public domain.

7. Determination of the similarity measures of dissertation annotations made by the dissertator and automatically generated by different approaches.

8. Construction of membership functions for annotations created by the dissertator based on the calculated similarity measures with automatically generated annotations.

9. Automation of research on the internationality of scientific events.

10. Classification of publications submitted to the scientific event according to the declared tracks (sections) of the scientific event.

11. Automatic determination of the level of scientific results and the quality of scientific activity of a researcher using the formula of the best teacher.

12. Dynamic automatic supplementation of the teacher's scientific performance.

13. Automatic determination of the number of self-citations in scientific texts that are in the public domain.

14. Building graphs related to mutual citations of different authors in scientific papers.

15. Study of cycles in references graphs in cases of indirect (cyclic) references.

16. Study of the level of cooperation of scientists, i.e. the ratio of the total number of scientific papers written in co-authorship to the total number of co-authors and the number of published scientific papers.

Many challenges still exist, but significant progress has been made in the field of natural language processing in recent years. Today, the maturity of natural language processing is encouraging more and more companies to use natural language processing in their products or in their internal organisation [31].

7.2. Description of the approach to finding keywords from annotations

Heuristic E5. The keywords reflect the content and direction of the dissertation to a sufficient extent and can be used to determine the similarity of research areas in the works.

Heuristic E6. The degree of similarity between the keyword sets of any two dissertations sufficiently reflects the similarity of the content of the dissertations (for some research areas and decision-making situations).

Heuristic E7. The study of the similarity of keyword sets can be applied (used) to identify clusters of scientific research groups and to identify similarities in research interests of researchers.

The intersections of interests between branches of science based on keywords will be investigated using decision theory methods [32, 33].

7.3. Experimental research on identifying similarity between keywords from thesis abstracts

To determine the interrelationships and additional structuring of the NPs, the similarity analysis between the dissertations was carried out using the following algorithm (Fig. 3). The algorithm (Fig. 4) was implemented in the Orange Data Mining analytical system (open source software). The widgets of the analytical platform allow the use of visual programming within which analytical procedures are created by linking certain blocks (widgets). The proposed scheme for determining similarity distances between dissertations is shown in Figure 5.

In this case, the widgets Corpus, Preprocess Text, Bag of Words, Distances and Distance Matrix are used.

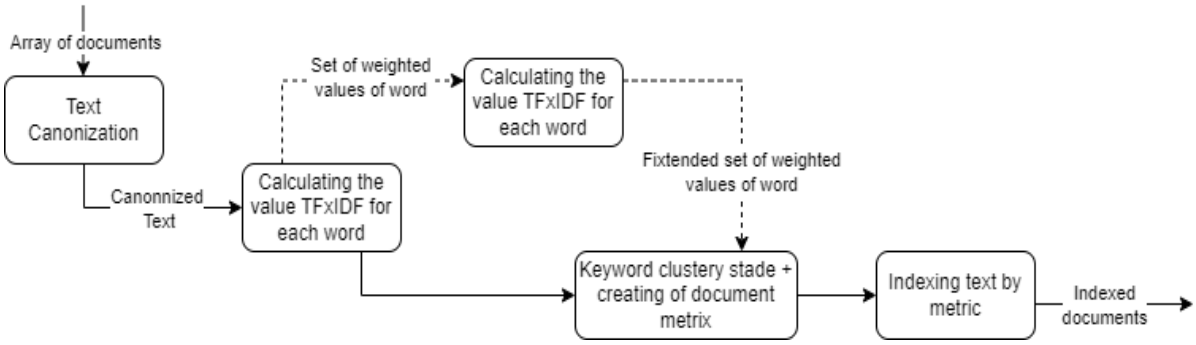


Figure 4. Context diagram of the algorithm for checking similarity between dissertations

The Corpus widget allows you to transform the input text data into a corpus of text documents. Preprocess Text splits the text into smaller units, filters them, and performs normalisation (stemming, lemmatisation). Text processing was performed on English-language dissertation annotations. The Bag of Words widget creates a corpus with the number of words for each instance of the document data, the count value is set to absolute, and the frequency is set to IDF m, binary (contains or does not contain) or sublinear (logarithm of the frequency term). The Jaccard metric is selected as the similarity distance metric in the Distances widget settings. The distances are visualised using the Distance Matrix widget (Fig. 6). The size of the distance matrix is 3452x3452.

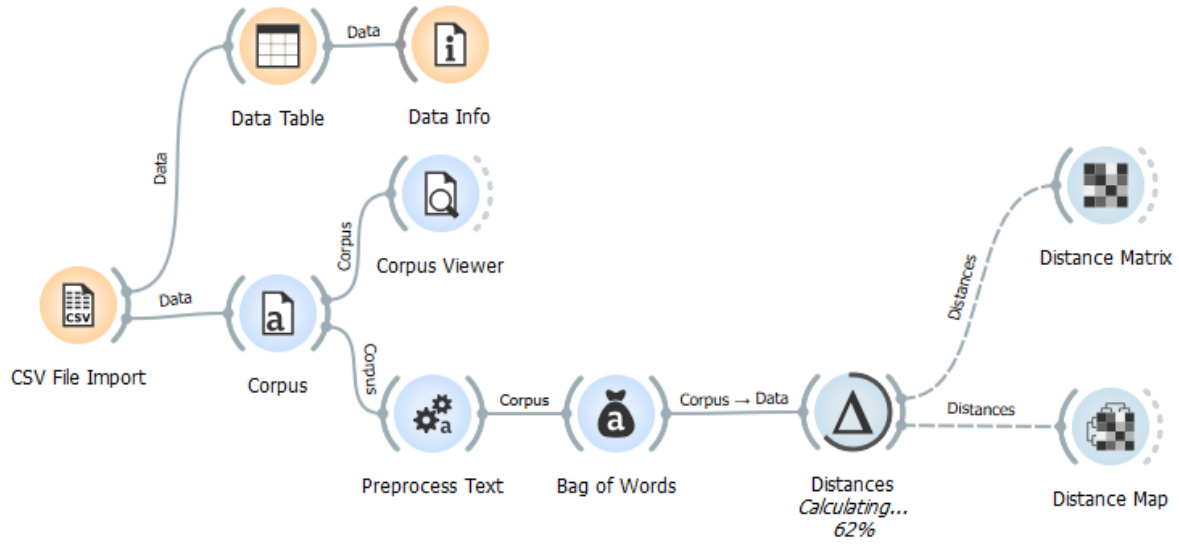


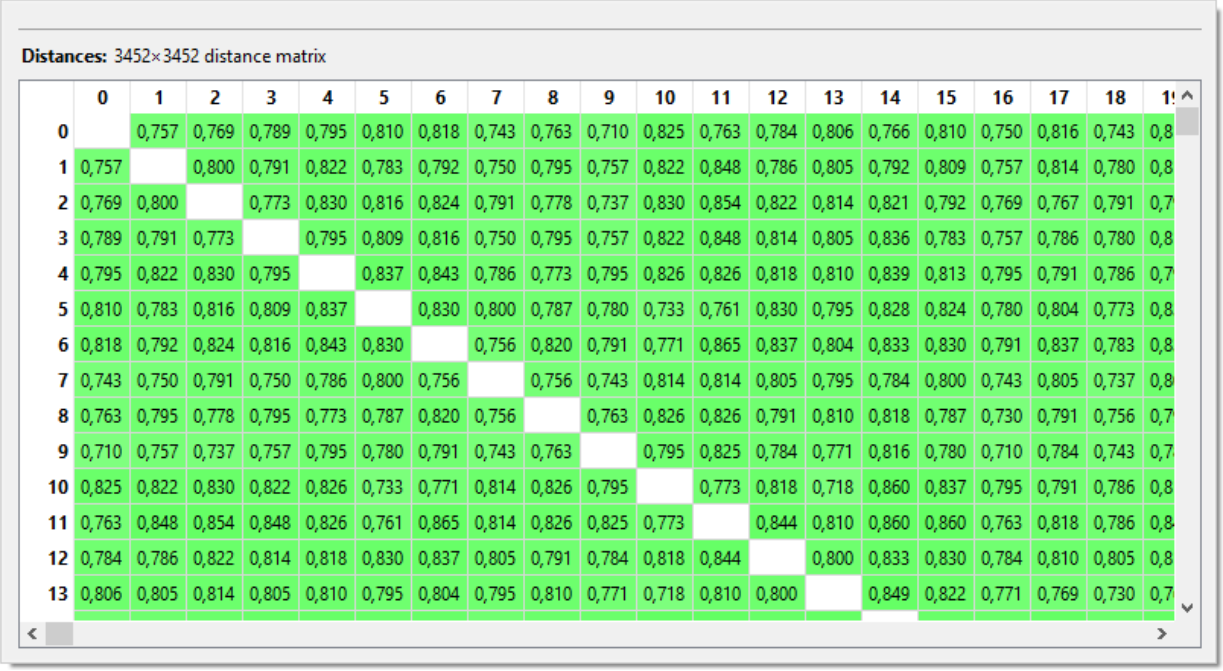
Figure 5. Scheme for determining similarity distances in Orange Data Mining

8. Prospects for further research

For the purpose of a more detailed and comprehensive structuring of the NP, a study of dissertations in different areas may be carried out in the future:

- in the context of the fields of science;
- taking into account the dynamics of protection over the years;
- correlation of scientific centres in cities or subordination to ministries or fields of science;
- researching doctoral and PhD theses separately;
- conducting research only in the context of completed (a_7) and separately - in the context of defended (a_9, a_{11}) dissertations;
- research of research centres - organisations in cities;
- in-depth analysis of cycles: the relationship between the centres where theses were written ($\mu(a_7)$) and defended (, $\mu(a_9)$ $\mu(a_{11})$).

where , $\mu(a_i)$ $i = 7,9,11-$ are the cities where the respective organisations are located.



	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
0		0,757	0,769	0,789	0,795	0,810	0,818	0,743	0,763	0,710	0,825	0,763	0,784	0,806	0,766	0,810	0,750	0,816	0,743	0,8
1	0,757		0,800	0,791	0,822	0,783	0,792	0,750	0,795	0,757	0,822	0,848	0,786	0,805	0,792	0,809	0,757	0,814	0,780	0,8
2	0,769	0,800		0,773	0,830	0,816	0,824	0,791	0,778	0,737	0,830	0,854	0,822	0,814	0,821	0,792	0,769	0,767	0,791	0,7
3	0,789	0,791	0,773		0,795	0,809	0,816	0,750	0,795	0,757	0,822	0,848	0,814	0,805	0,836	0,783	0,757	0,786	0,780	0,8
4	0,795	0,822	0,830	0,795		0,837	0,843	0,786	0,773	0,795	0,826	0,826	0,818	0,810	0,839	0,813	0,795	0,791	0,786	0,7
5	0,810	0,783	0,816	0,809	0,837		0,830	0,800	0,787	0,780	0,733	0,761	0,830	0,795	0,828	0,824	0,780	0,804	0,773	0,8
6	0,818	0,792	0,824	0,816	0,843	0,830		0,756	0,820	0,791	0,771	0,865	0,837	0,804	0,833	0,830	0,791	0,837	0,783	0,8
7	0,743	0,750	0,791	0,750	0,786	0,800	0,756		0,756	0,743	0,814	0,814	0,805	0,795	0,784	0,800	0,743	0,805	0,737	0,8
8	0,763	0,795	0,778	0,795	0,773	0,787	0,820	0,756		0,763	0,826	0,826	0,791	0,810	0,818	0,787	0,730	0,791	0,756	0,7
9	0,710	0,757	0,737	0,757	0,795	0,780	0,791	0,743	0,763		0,795	0,825	0,784	0,771	0,816	0,780	0,710	0,784	0,743	0,7
10	0,825	0,822	0,830	0,822	0,826	0,733	0,771	0,814	0,826	0,795		0,773	0,818	0,718	0,860	0,837	0,795	0,791	0,786	0,8
11	0,763	0,848	0,854	0,848	0,826	0,761	0,865	0,814	0,826	0,825	0,773		0,844	0,810	0,860	0,860	0,763	0,818	0,786	0,8
12	0,784	0,786	0,822	0,814	0,818	0,830	0,837	0,805	0,791	0,784	0,818	0,844		0,800	0,833	0,830	0,784	0,810	0,805	0,8
13	0,806	0,805	0,814	0,805	0,810	0,795	0,804	0,795	0,810	0,771	0,718	0,810	0,800		0,849	0,822	0,771	0,769	0,730	0,7

Figure 6. A fragment of the distance matrix in Orange Data Mining

By applying and implementing the results of the analysis in practice, the interaction between research centres can achieve a more efficient management of research processes [34, 35].

It is possible to identify trends in scientific cooperation and predict further cooperation between scientific schools [36, 37]. It is also possible to improve the level of organisational culture among scientific organisations, which will contribute to the efficiency of scientific institutions and enhance synergies [38, 39].

Artificial intelligence methods should also be used to analyse theses defended in Ukraine.

9. Conclusions

The paper examines the concept of scientific space and its peculiarities in Ukraine. The paper presents approaches to the analysis of dissertations defended in Ukraine in 1993-2020. An analysis of Ukrainian cities in which theses were written and defended is carried out. These cities are defined as scientific centres. Thus, a preliminary structuring of the NPs in terms of the preparation and defence of dissertations was carried out. Models have been developed and directions for further research of Ukraine's NPs have been identified, in particular, the analysis of dissertation defence in Ukraine and all possible scientific interconnections between teams of scientists related to the procedures for dissertation research and dissertation defence.

10. References

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