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Application of Neural Network in the Discovery of Functional Knowledge Based on the Rational Education of Avicenna and Kant

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ABSTRACT

The aim of this research is to employ neural networks in discovering functional knowledge based on the rational training of Avicenna and Kant. The methodology of this study is based on deep learning neural networks, making it an exploratory research. Given the practicality of functional knowledge, this research is applied in nature. To assess the significance of components and evaluation indicators of functional knowledge, text mining and the frequency of related symbols have been used. In order to utilize data mining techniques in this research, the WEKA software has been employed. The algorithms considered for implementation in this study are MLP, SVR, AdaBoost.R, Bagged Trees (BAGTREE), Linear Regression (LR), and Least Squares Support Vector Regression (LSSVR). According to the results obtained for functional knowledge, the LSSVR and SVR methods outperform the others, indicating their superiority. As the charts illustrate, there is significant volatility in this dataset, making prediction challenging. Furthermore, the R2 value is very close to one, indicating relatively accurate predictions by the methods. Neural networks can serve as powerful tools to aid in rational thinking, logical decision-making, and better understanding of the surrounding world, in line with the perspectives of Avicenna and Kant. These tools can assist in analyzing and interpreting complex data in these fields and strive for rationality and human excellence.

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1. Introduction

The use of neural networks in the analysis and deep understanding of historical figures can contribute to rational education (Lombardi and Marinai, 2020). These networks can analyze historical texts and the works of historical figures, identifying hidden patterns in their thoughts and actions. On the other hand, rational education can employ deep learning tools to facilitate the process of analyzing personalities and their theories. Neural networks and deep learning techniques have emerged as some of the most powerful data analysis and prediction tools in recent decades. These techniques enable us to harness large and complex datasets, discern hidden patterns and relationships within the data. By leveraging these technologies, we can accurately analyze the functional knowledge of historical figures and examine their impacts on societies and literature under investigation (Alzubaidi et al., 2021).

Functional knowledge refers to understanding and analyzing not only the thoughts and theories of individuals but also the practical and applied effects of their ideas and opinions on societies and cultures. In the case of two prominent historical figures like Avicenna and Immanuel Kant, the analysis of their functional knowledge can assist us in gaining a deeper understanding of the impacts of their thoughts and theories on their respective times and their relevance to contemporary issues (Alvandian & Badeshti, 2018). Analyzing the functional knowledge of important historical figures helps us establish the connections between their thoughts and actions within culture and history. This analysis can provide us with valuable insights into their influence on society, science, philosophy, and literature. Furthermore, it can aid in comprehending contemporary issues and the current needs of societies (Forouzian et al., 2021).

The problem facing today's world is not a lack of information but rather a shortage of reliable knowledge (CheshmehSohrabi et al., 2023). The goal of neural networks in historical records is to identify relationships among existing data and extract knowledge from them. When the available data is structured, the use of data mining methods and the extraction of mathematical patterns from it are straightforward (Masjedy et al., 2022). However, nowadays, a significant portion of past information and knowledge is stored in textual form, and texts contain unstructured data. To extract and discover knowledge from textual information, an individual must first comprehend it to understand the meanings and concepts it contains and the relationships between them. Nevertheless, in the age of technology and data, automation is sought, even if it involves understanding text-based knowledge (Salehi, 2021).

Neural network analysis of the educational texts of Avicenna (Hajar, 2013) and Kant's teachings (Alvargonzález, 2022) provides a means for discovering functional knowledge related to education and training, which are essential needs and tools for transmitting both material and spiritual values of humanity. Reason holds a special place in the analysis of information and its application in all aspects of life (Putri and Nurhuda, 2023). The coordination of actions and speech in humans based on reason and the use of intellect in their epistemology are among the most fundamental individual, cultural, and societal characteristics. This is because the utilization of rationality has been introduced as a factor in the growth and development of societies and individuals. Since humans possess the capacity to perceive all available knowledge, they can comprehend all general and specific truths (Chia, 2022). The value of Avicenna's thoughts in the realm of functional knowledge and reason in educational philosophy is discovered through the extraction of knowledge from the valuable texts of this scholar (Aprison, 2021). Therefore, the combination of neural network techniques and rational education creates the possibility to delve deep into the functional knowledge of historical figures such as Avicenna and Kant, and to elucidate their impacts on contemporary societies and the world (Benna, 2023). This connection between these two domains can assist

individuals in better understanding history and cultural values while contributing to the enhancement of knowledge and scientific insight. In this research, an effort has been made to use neural networks in ontology, epistemology, axiology, and anthropology related to these scholars, taking into account the empiricism of Avicenna and Kant (Schierbaum and Perälä, 2020). The aim is to provide a clear and comprehensible portrayal of the foundational ideas in the field of functional knowledge in education and training. By extracting principles, objectives, and methods, it seeks to shed light on the educational implications and contribute to a cognitive constructivist model in anthropology for the perception of rational education in the context of Avicenna and Kant. Therefore, the current research aims to address the following questions:

1. What functional knowledge does the extraction of semantic relationships in the educational sources of Avicenna and Kant reveal?
2. To what extent is the neural network method accurate in augmenting the extracted knowledge from the texts of Avicenna and Kant?

2. Literature Review

Considering studies that have focused on the foundations of functional knowledge, rationalism, or educational aspects of Avicenna. Salleh and Embong (2017) examined the educational perspective and educational knowledge of Avicenna, demonstrating that a systematic review can shed new light on Avicenna's knowledge. Aprison (2021) investigated the educational knowledge of Avicenna through content analysis in terms of functional knowledge. Gharayaq Zandi (2020) examined leadership knowledge in the thoughts of Avicenna, showing that Avicenna's desired knowledge is not only conventional but must also have a proper internal mechanism for individuals to attain the highest level of habitual knowledge and intelligence. Putri and Nurhuda (2023), in their exploration of educational and pedagogical knowledge of Avicenna, highlighted the authenticity and proximity of his thought to functional knowledge. Wang et al. (2023), in a study titled "Architectural Pulls: A Nonchalant Deep Learning Approach," used the SDA method to understand visual patterns, recognize handwritten text of Avicenna, and classify natural images. They demonstrated that neural network methods exhibit high capabilities in traditional feature learning models and relevant deep learning models.

Considering the mentioned studies, each of them individually examines a component such as anthropology, Islamic education, or epistemology solely based on the knowledge of Avicenna as an example. Now, with reference to these examples, there arises a necessity for a comprehensive and authoritative source that facilitates access to the maximum components mentioned and operates cohesively. Based on the research objective, a method of conceptual analysis and interpretation has been employed. In this deep learning method, the semantic elements of a concept, the relationships between these elements within the context of a concept, and their connections with other concepts that are somehow related to it are explored (Bave, 2019).

Tayarani and Jalali (2019) introduced data mining as a reliable and credible method for discovering knowledge in texts. Rafiei and Keramatfar (2022) emphasized the importance of deep learning methods and demonstrated that the average growth rate of scientific documents in Iran in the field of text mining is higher than in other subject areas.

Based on the conducted studies, it can be said that both Avicenna and Kant were significant figures in the history of philosophy and science, offering complex and profound philosophies. Analyzing their functional knowledge requires a deep understanding of their philosophies and their impacts. Neural networks can leverage the intricacies of these philosophies and their connections to other concepts. Information related to Avicenna and Kant is available in written texts. Neural networks, equipped with text processing capabilities, can analyze these texts and extract valuable insights from both a rational and scientific perspective.

Therefore, the analysis of the functional

knowledge of individuals like Avicenna (Ghaffari, 2015) and Kant (Attar, 2012) necessitates the integration of philosophical, historical, cultural, and scientific knowledge. Neural networks can make use of the diverse knowledge in these domains and identify the relationships between them. Additionally, humans as social and cultural beings are inherently connected to the knowledge and theories of historical figures. Neural networks can also assist in analyzing functional knowledge from this perspective.

Neural networks can not only analyze the functional knowledge of historical figures but can also predict how these philosophies and theories will impact the future. Consequently, the use of neural networks in rational education and the discovery of functional knowledge in the context of Avicenna and Kant can aid in achieving a more precise and in-depth analysis of their philosophies and their effects. It can lead to a better understanding of their place in history and philosophy. Furthermore, it has been demonstrated that by using this combination, scientific and rational knowledge can be enhanced through advanced technologies, allowing for their utilization in contemporary programs and decision-making processes.

3. Methodology

Considering the research topic, the methodology employed in this research is based on deep learning neural networks, making it an exploratory study. Given the practical nature of functional knowledge, this research is applied in its approach. The research's execution model, as previously described, conforms to Figure 1.

To assess the significance of components and evaluation indicators in functional knowledge, text mining techniques and the frequency of relevant symbols have been utilized. For the application of data mining techniques in this research, the WEKA software has been employed. To achieve accurate and cohesive results, the data were initially separated based on textual content classified under the categories of Avicenna and Kant. The selected dataset is structured so that each type of text and document possesses an educational attribute, as outlined in Table 1:

Table 1. *Characteristics of the reviewed texts*

Educational structural feature	**key words**	
	Avicenna	**Kant**
Ontology	Nature and existence	existence
Epistemology	Experience and receive	Existential category
Values	Objectivity	The distinction
Anthropology	goal oriented	rightist

Given that the desired dataset in this project was stored as a collection of separate files, there was a need for actions to harmonize and structure the data. Therefore, valuable information was extracted from the electronic files and stored as an information system, ultimately being converted into an Excel file.

The extraction of useful information from the collection of electronic files available in various sections was carried out using an internal organization program known as the Information System. Subsequently, the data was integrated into a unified Excel file.

During this stage, data cleansing was performed, and non-conforming data were removed. The analytical model of this study, which is an extension of a validated prediction model and is presented for the first time in this research, requires compliance with prediction algorithms. One of these stages involves data normalization. The input data is normalized as follows (Prusa & Khoshgoftaar, 2017):

$$x_i = \frac{x_i - x_{\min}}{x_{\max} - x_{\min}}$$

In which, $x_i$the value of the i-th feature, x_{min} is the lowest value of the feature and $x_{max}$the highest value of the desired feature. Normalizing the data gives a better result from the implementation of different models. Forecasting is the same as classification, with the difference that in forecasting algorithms, the results occur in the future. Some of the famous Prediction techniques are Nonlinear Regression, Linear Regression, Decision Tree and Neural Networks. In this article, a number of these methods are used as a comparison method (Alsayat & Ahmadi, 2023).

By taking the necessary steps to prepare the data, the minimum requirements for a dataset for modeling using clustering techniques in data mining have been established. However, since modeling is done using specialized data mining software, and the most reputable software in data mining is currently WEKA, data format adjustments were made at this stage. By performing these actions, the created dataset became ready for the modeling process.

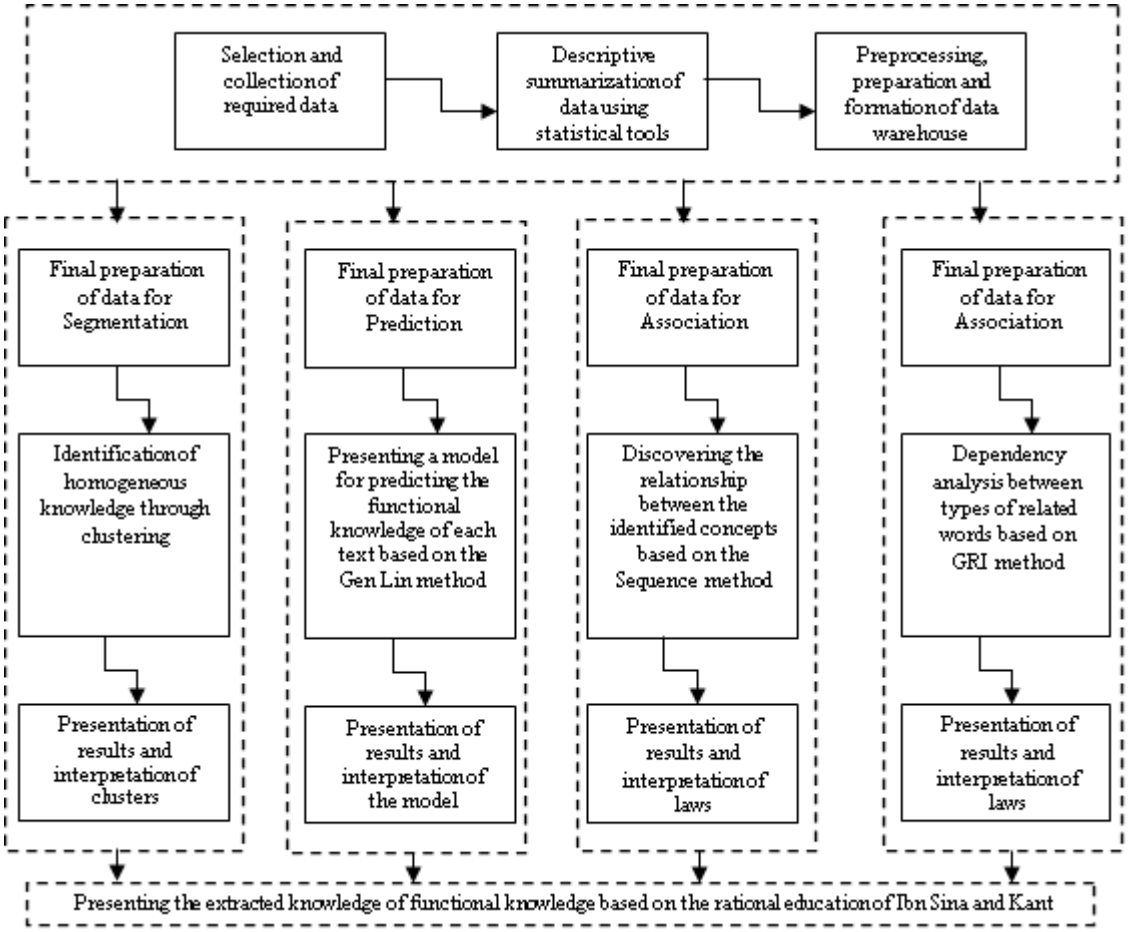

***Figure1**. the stages in WEKA*

4. Findings

By utilizing data mining techniques, it is possible to create a model for predicting functional knowledge. In fact, the feasibility of presenting a neural network-based model has been demonstrated, and it can be employed for optimizing functional knowledge. Therefore, various regression methods should be applied to make comparisons and select the best approach. Various linear regression methods that are optimized using the least squares error method can be used for comparison. Artificial neural networks, which essentially operate based on non-linear regression, have been widely used in predictive tasks, with the results of studies indicating their high accuracy.

The neural network used in this study consists of two hidden layers, with each layer containing five neurons. The number of epochs for the network is set to 100. These values have been determined through trial and error. The network is trained for all training data minus the test data, and the trained network is then applied to the test data. The algorithms considered for implementation in this study are as follows: MLP, SVR, AdaBoost.R, BAGTREE, LR, and LSSVR.

For training and testing, the leaving-one-out method was employed. In this method, during each iteration, one data point is used as a test set, while the rest of the data points are used for training, and this process is repeated for all data points. The advantage of this method is that all data points are used for testing once. In Figure 2, the

classification attributes in the WEKA software are illustrated.

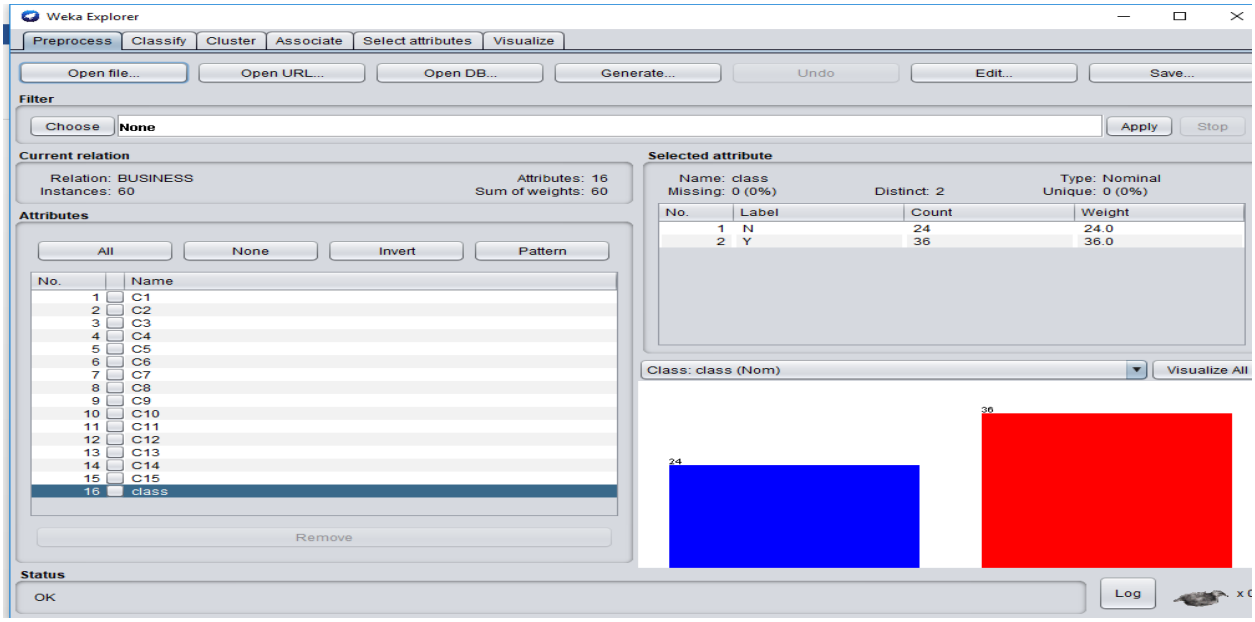

Figure 2. *Classification of data (according to Avicenna and Kant)*

In the entered data, two categories of the amount of applied knowledge and the amount of prediction are specified. Figure (3) shows a view of the implementation of data in the MLP model in Weka software:

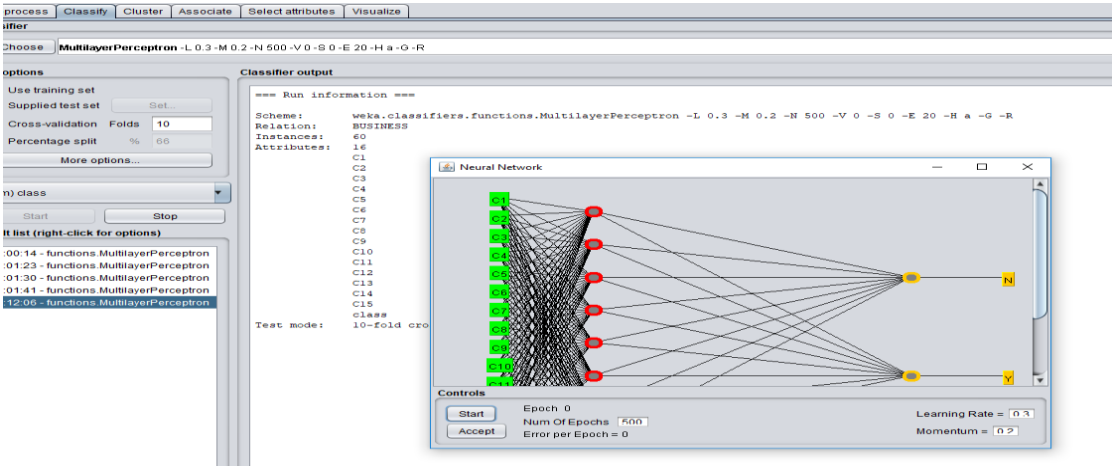

Figure 3. *Implementation of data in the MLP model*

In the following, two types of texts of Avicenna (Dalfardi et al., 2014; Kaukua, 2020) and Kant (Woleński, 2019) are used as examples, and all the methods are applied to them and reported. Table 2 shows the results of applying the introduced algorithms in the proposed methods on the existing data of Avicenna, which shows the predicted functional knowledge.

Table 2. *The results of applying the introduced algorithms on the existing data*

R2	RMSE	MAPE	MAE	MSE	Measure / Methods
0.7	28.13	2.16	14.63	530.24	MLP
0.75	18.88	1.33	13.57	401.13	AdaBoost.R
0.82	16.25	1.86	12.54	288.22	BAGTREE
0.82	15.14	1.43	10.78	246.27	SVR
0.84	16.57	1.64	10.36	281.54	LR
0.85	17.36	1.58	11.26	266.18	LSSVR

Figure 4 shows the amount of applied and predicted ontology by AdaBoost.R algorithm. In this figure, the red line represents the predicted value and the blue line represents the applied value of functional knowledge.

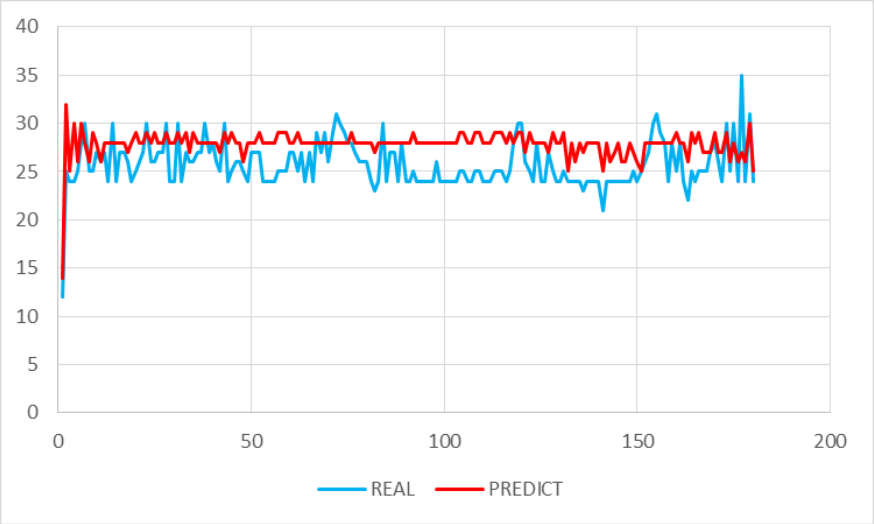

Figure 4. *The amount of ontology applied and predicted by the AdaBoost.R algorithm on the texts of Avicenna and Kant*

Figure 5 shows the amount of applied and predicted epistemology by LR algorithm. In this figure, the red line represents the predicted value and the blue line represents the applied value of functional knowledge.

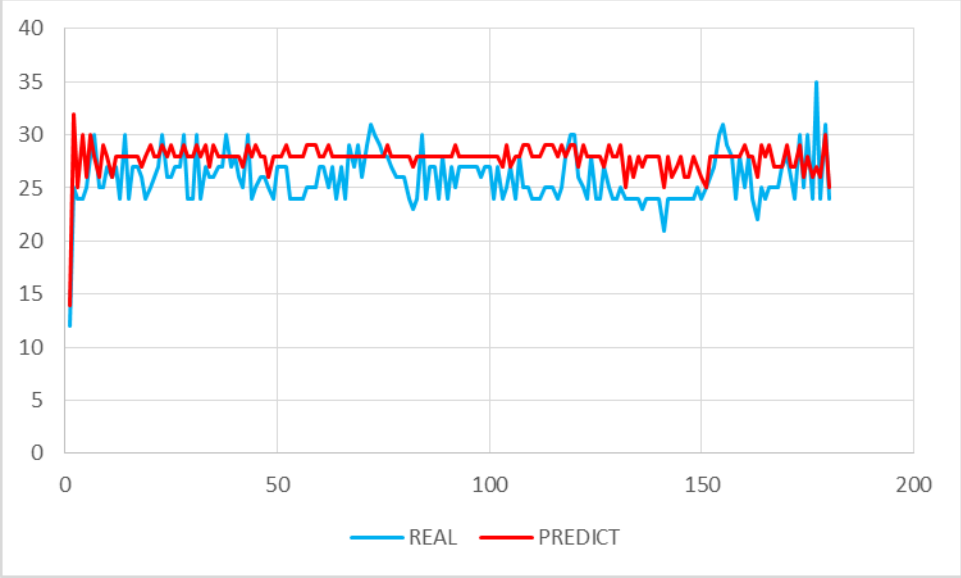

Figure 5. *The amount of epistemology applied and predicted by the LR algorithm on the texts of Avicenna and Kant*

The amount of usage and predicted value by BagTree algorithm is shown in Figure 6. In this figure, the red line represents the predicted value and the blue line represents the applied value of functional knowledge.

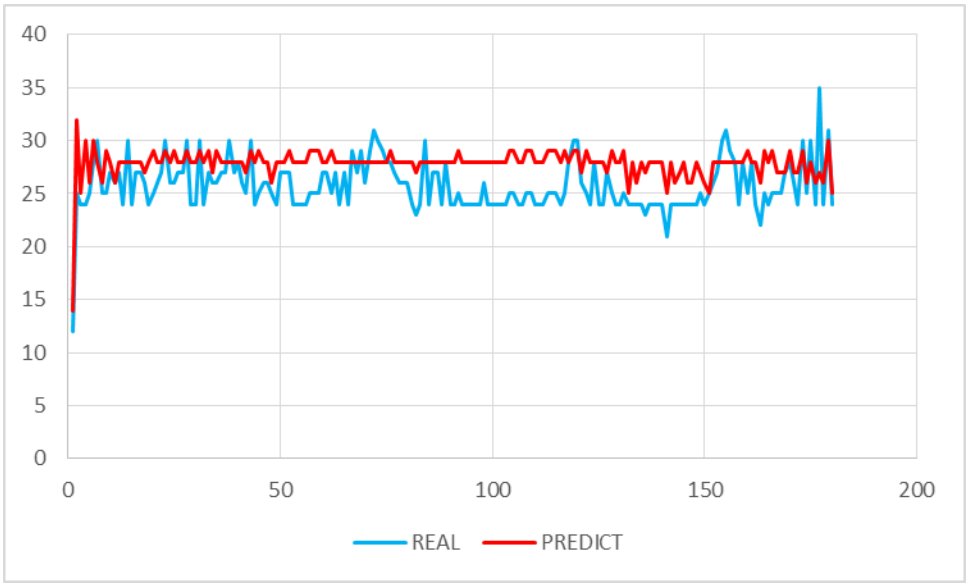

Figure 6: Applied and predicted valorization rate by BagTree algorithm on the texts of Avicenna and Kant.

The amount of anthropology applied and predicted by the LSSVR algorithm is shown in Figure 7. In this figure, the red line represents the predicted value and the blue line represents the applied value of functional knowledge.

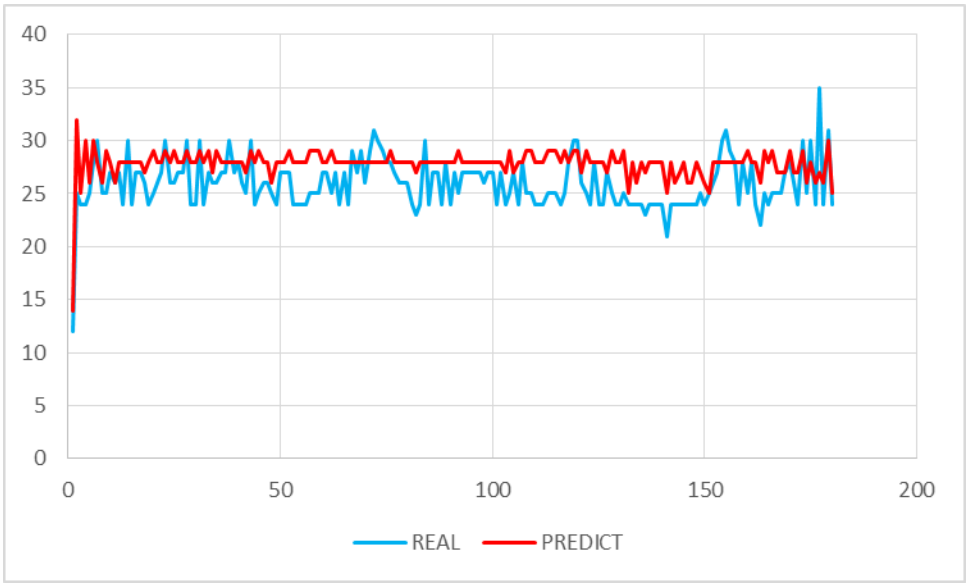

Figure 7: The amount of applied anthropology and predicted by the LSSVR algorithm on the texts of Avicenna and Kant

Finally, the amount of applied and predicted functional knowledge by the SVR algorithm is shown in Figure 8. In this figure, the red line represents the predicted value and the blue line represents the applied value of functional knowledge.

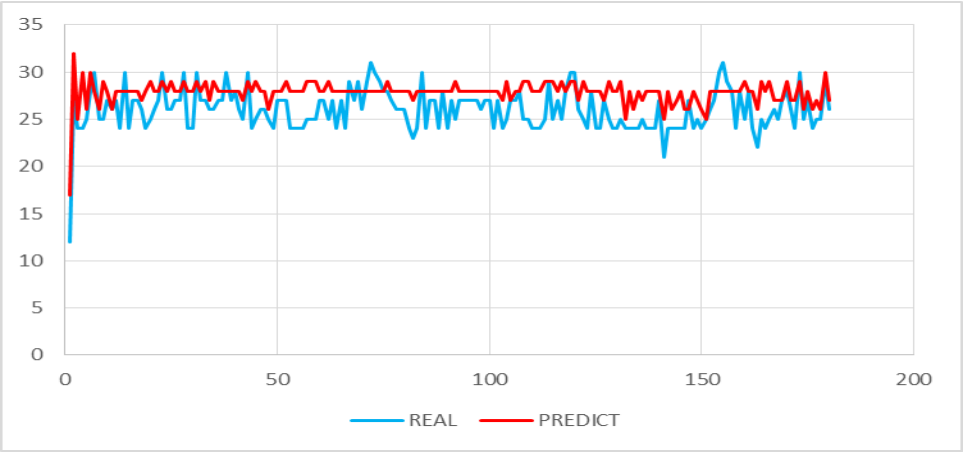

Figure 8. *The amount of actual and predicted functional knowledge by the SVR algorithm on the texts of Avicenna and Kant*

As the results show, for functional knowledge, LSSVR and SVR methods have better results than other methods, which shows its superiority. As the graphs show, there are very high fluctuations in this data set and this makes prediction very difficult. As the R2 value of the results is very close to one, which shows the relatively accurate prediction of the methods. The development of educational cases in texts based on vocabulary is shown in Figure 9.

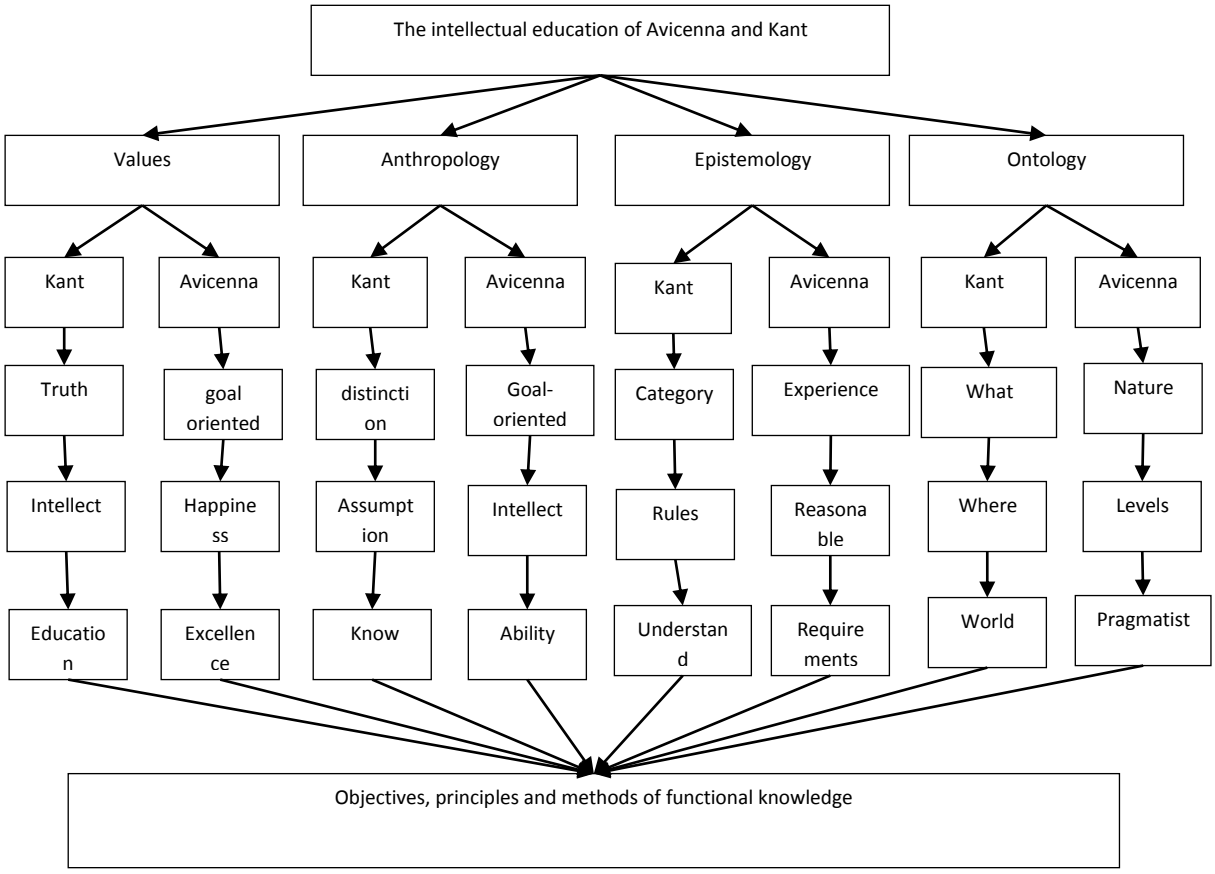

Figure 9. *Words found based on neural network data mining for the application of functional knowledge in texts*

Based on the obtained words, all dimensions of functional knowledge can be visualized in these texts based on the neural network and the repetition of these words.

Neural networks have made significant strides in various fields, including philosophy and education, by aiding in the exploration and discovery of functional knowledge. When considering the rational education philosophies of Avicenna and Kant, neural networks can be applied in several ways across the domains of values, anthropology, epistemology, and ontology.

Values: Neural networks can assist in understanding and analyzing the values proposed by Avicenna and Kant in their philosophies. They can help identify patterns in moral or ethical frameworks proposed by these thinkers, enabling a deeper exploration of their value systems. Neural networks can process vast amounts of philosophical texts and extract underlying principles or ethical guidelines, shedding light on the nuances and intersections of values within their educational philosophies.

Anthropology: Utilizing neural networks, researchers can delve into Avicenna's and Kant's perspectives on human nature, consciousness, and the self. By analyzing their writings, neural networks can extract underlying anthropological concepts and aid in uncovering the fundamental beliefs about human existence, cognition, and identity present in their educational philosophies.

Epistemology: In the realm of knowledge and epistemology, neural networks can help map the reasoning and methodologies advocated by Avicenna and Kant. They can analyze their approaches to learning, perception, and the acquisition of knowledge. Neural networks may reveal connections between their epistemological stances, enabling a better understanding of how they perceived the nature and limits of human knowledge within their educational frameworks.

Ontology: Regarding ontology, neural networks can assist in deciphering Avicenna's and Kant's views on existence, reality, and the nature of being. By processing their philosophical treatises, neural networks might uncover ontological principles and distinctions concerning the nature of reality, existence, and the relationship between individuals and the world they inhabit within their educational theories.

However, it's important to note that while neural networks can aid in analyzing texts and uncovering patterns, the interpretation of philosophical concepts still heavily relies on human philosophical insight and interpretation. These tools can assist in organizing and highlighting patterns within the writings of these philosophers, but the philosophical analysis itself requires human expertise and critical thinking.

5. Discussion

It has been demonstrated that the use of neural networks for the exploration of functional knowledge in line with the perspectives of Avicenna and Kant in the fields of ontology, epistemology, anthropology, and axiology can yield valuable insights. The results indicate that neural networks can assist in dissecting the concepts of existence and human nature. By training these networks, differences and diverse experiences of individuals can be understood, and comprehensive information regarding the impacts of existence and being on human behavior and decision-making can be gathered. Neural networks can be employed in the study and analysis of human thought and epistemological issues, aiding in the development of logic and rational reasoning. They contribute to individuals' better understanding of philosophical definitions and concepts.

Furthermore, neural networks can be utilized to learn from human behavior and performance in various learning environments. These analyses can help comprehend the factors influencing social and cultural behaviors of individuals, ultimately contributing to the enhancement of social and cultural interactions. The proposed model of functional knowledge delves into the study of values and ethical principles of individuals and societies, facilitating better understanding of the values that assist in rational education. This analysis

can aid in individual and social ethical decision-making and value-based choices. Ultimately, neural networks serve as powerful tools to foster rational thinking, logical decision-making, and a better understanding of the surrounding world, playing a significant role in rational education based on the perspectives of Avicenna and Kant. These tools can assist in the analysis and interpretation of complex data in these domains, striving for human rationality and excellence.

6. Conclusion

Neural networks have been instrumental in various fields, including the exploration of philosophical and rational education concepts advocated by thinkers like Avicenna and Kant. Avicenna, a Persian polymath, and Kant, a renowned Enlightenment philosopher, both emphasized the importance of reason and knowledge acquisition. Networks can analyze extensive philosophical texts written by Avicenna and Kant. Through natural language processing (NLP), these networks can extract key concepts, relationships between ideas, and philosophical arguments. This analysis can help in understanding their rational education theories better.

Neural networks excel in pattern recognition. They can identify recurring themes or concepts within the philosophical works of Avicenna and Kant. By recognizing these patterns, the networks can aid in understanding the structure and development of their philosophical ideas.

Neural networks can simulate philosophical dialogues based on the writings of Avicenna and Kant. By training on their texts, these models can generate hypothetical discussions, potentially leading to new insights or interpretations of their ideas.

Leveraging neural networks' recommendation abilities, personalized educational material aligned with the rational education principles of Avicenna and Kant can be suggested to learners. These systems can cater to individual learning styles and preferences, enhancing the understanding of philosophical concepts. Both Avicenna and Kant discussed ethics extensively. Neural networks can be used to develop models that simulate ethical decision-making processes based on their philosophical frameworks. These models could be used for moral reasoning and educational purposes.

In conclusion, neural networks offer a range of tools and methodologies that can be employed to delve deeper into the rational education philosophies of Avicenna and Kant. By leveraging these technologies, we can extract, analyze, and interpret their ideas in ways that may enrich contemporary understanding and application of their teachings in education and philosophy.

The application of neural networks in discovering functional knowledge from the rational education of philosophers like Avicenna and Kant involves leveraging advanced computational methods to analyze, interpret, and potentially derive insights from their philosophical works.

Avicenna, a prominent Persian polymath, and Kant, a key figure in modern Western philosophy, both contributed significantly to epistemology, metaphysics, and ethics. Their writings contain complex reasoning, systematic approaches, and profound insights into human thought and existence.

-Neural networks can be trained on the writings of Avicenna and Kant to analyze the structure, semantics, and concepts within their texts. Natural Language Processing (NLP) models can help identify key themes, connections between ideas, and recurring philosophical concepts.

- By processing philosophical arguments and theories through neural networks, it's possible to identify recurring patterns or logical frameworks employed by these thinkers. This can assist in understanding their systematic approaches to knowledge and ethics.

- Neural networks can aid in extracting valuable insights or principles from the philosophical texts of Avicenna and Kant. They can identify and categorize ideas, potentially revealing implicit connections or overlooked concepts.

- These networks can facilitate comparative studies between the works of Avicenna and Kant, highlighting similarities or differences

in their approaches to rational education and functional knowledge. This could shed light on universal themes or divergent perspectives.

- Neural networks might reveal subtle suggestions or implicit ideas embedded within the writings of these philosophers that contribute to understanding their educational philosophies.
- Analyzing their texts through neural networks might unveil educational methodologies or suggestive patterns used by Avicenna and Kant to convey their philosophical concepts.

However, it's essential to note that while neural networks can aid in analyzing texts and identifying patterns, the interpretation of philosophical ideas often requires human expertise and contextual understanding. Philosophical concepts are nuanced and subjective, requiring critical thinking and philosophical acumen to derive meaningful interpretations and applications.

Utilizing neural networks in this context would be an innovative approach to extracting, organizing, and potentially synthesizing knowledge from the rich philosophical heritage of Avicenna and Kant, contributing to interdisciplinary studies at the intersection of philosophy and artificial intelligence.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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