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THE ROLE OF LINGUISTICS IN AI: UNDERSTANDING HUMAN LANGUAGE PROCESSING BY MACHINES

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Abstract

The advent of artificial intelligence (AI) has greatly changed the processing, interpretation, and production of human language. In this study, the use of linguistics in AI is explored through investigating how phonology, morphology, syntax, semantics, pragmatics, and discourse influence natural language processing (NLP). Qualitative, descriptive, and literature-based research methodologies were employed using selected literature written between 2022 and 2025. The paper will be concerned with the evolution of NLP from rule-based to statistical models, followed by machine learning, deep learning, and large language models. The research has shown that linguistic principles play a vital role in creating the basis for grammatical parsing, semantic interpretation, context comprehension, and human-computer interaction. Some of the main applications of NLP include chatbots, healthcare and public health, software requirements engineering, business analytics, and automated communications. Nonetheless, issues such as linguistic ambiguity, cultural diversity, multilingualism, small data sets, algorithmic biases, and lack of transparency still hinder reliable functioning of AI language applications. The paper further draws the distinction between natural language understanding and natural language generation and demonstrates that fluency in language does not mean comprehension. Conclusively, the paper argues that AI-based language processing is contingent on collaboration among linguistic theories and computational approaches. The suggestions include developing multilingual data sets, developing explanations for NLP, ethics of evaluation, contextual processing, and inter-disciplinary research. This study adds value to knowledge of how linguistics may contribute to the development of better AI-based language technologies.

1. INTRODUCTION

AI technology has changed the dynamics of the interaction between human beings and computers by making it possible for computer programs to perform activities which need human intelligence. Of the various developments in AI, NLP has proved to be very significant since it makes it possible for the machine to process natural languages. NLP involves computer science, linguistics, and machine learning as well as the computational approach of processing language by computer so as to make interaction possible between

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human beings and computers. Machine translation, virtual assistants, chatbots, sentiment analysis, and automatic text generation are some of the uses of NLP which have proved to be essential in the current times (Abdulla et al., 2022).

The language is a complicated system consisting of sound, words, grammar, meaning, context, and communicative intent. Human beings use their linguistic knowledge as well as contextual, experiential, and background knowledge to process language. Machines cannot acquire language in the same way human beings do and they need computational approaches, training data, algorithms, and representation in order to recognize the language patterns and produce meaningful output. Linguistics provides very significant theoretical and analytical basis for these processes (Karanikolas et al., 2023).

However, the connection between the linguistics and AI appeared in computational linguistics that is concerned about the formal description of language and its computational aspects. Early NLP techniques relied on grammars, dictionaries, and symbolic representations that were elaborated manually. More recent approaches involve statistical modeling and machine learning where language structures can be learned from large amounts of textual data. Neural networks, transformers, and large language models brought new possibilities into the world of machine language processing (Lane & Dyshel, 2025).

The contribution of the linguistics to the AI is based on several branches of linguistics such as phonetics, phonology, morphology, syntax, semantics, pragmatics, discourse analysis, and sociolinguistics. Phonetics and phonology make contributions to the speech recognition and synthesis by studying sounds and their patterns. Morphology is involved in machine analysis of word construction and changes. Syntax makes contributions to the analysis of relationships between words in sentences. Semantics makes contributions to the understanding of meanings. Pragmatics studies meaning dependency on context, intention of speakers, and social environment. All of these aspects are needed for developing language processing techniques that go beyond word matching (Joshi et al., 2024)

There have been remarkable advancements made in the generation of coherent and contextually appropriate language by language models. However, coherence does not imply full human comprehension either. The system may generate grammatically correct sentences that may not understand ambiguities, cultural allusions, inferences, irony or contextual cues. Studies of the relationship between NLP and linguistics continue to highlight the significance of linguistic studies in evaluation, interpretability, explanation, low-resource language processing, and the study of language technologies (Fanni et al., 2023).

Therefore, the use of linguistics does not end with the development of language models. Instead, linguistic expertise plays a role in the development of language resources, evaluation of performance of models, design of multilingual systems and studying machine representation of linguistic knowledge. Linguistic expertise of humans is also vital in data annotation, evaluation, fine-tuning and language technology development in low-resource languages (Lenci & Padó, 2022).

1.1 Problem Statement

The emergence of new technologies related to the evolution of artificial intelligence has helped to enhance machines' ability to handle and generate human language. Nonetheless, human language is still hard to interpret for machines due to the fact that it includes ambiguity, context, culture, figurative language, grammatical variation, and social interaction. Even though contemporary NLP models are able to generate fluent and seemingly meaningful output, it might not necessarily mean that they are capable of interpreting the language contextually and correctly (Abd Ali, 2024).

One of the most problematic aspects in this regard is that there is a relatively poor involvement of explicit linguistic knowledge in many contemporary machine learning models. Although the models can detect

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statistical dependencies in languages, they may be inefficient in handling low-resource languages, complex grammar, cultural variations, and context-dependent meanings. Besides, the lack of linguistic evaluation makes it hard to decide if the model has generated meaningful language representations or is just copying patterns from the input

(Hussain et al., 2025)

In other words, the problem discussed in this study is the need to learn about the contribution of linguistic theory and computational techniques to the effective handling of machine language (Manning, 2022).

1.2 Research Objectives

Objectives of the study include:

1. To evaluate the importance of linguistics in the advancement of AI technology and NLP systems.
2. To highlight the methods of understanding human languages by machines using computational and machine learning models.
3. To evaluate the importance of phonology, morphology, syntax, semantics, and pragmatics in NLP.

1.3 Research Questions

1. What is the significance of linguistics in the field of artificial intelligence and natural language processing?
2. How does a machine interpret and process human language using computational techniques?
3. How does phonology, morphology, syntax, semantics, and pragmatics help in NLP?

1.4 Significance of the Study

The importance of this study is that it will help us understand the theoretical and practical aspects of the connection between linguistics and artificial intelligence. For further development of technologies that deal with human language and speech, understanding of this connection is crucial (Sharma et al., 2024).

Theoretical Importance: This research will give us insights into how linguistics helps in the computational processing of language. It will show us that even with the growing use of neural networks in NLP, the significance of linguistic knowledge cannot be overlooked.

Technological Importance: We will learn how linguistic knowledge helps to develop machine translators, conversational agents, speech technologies, information retrieval and generation systems. Moreover, this study will let us see the possibilities of combining machine learning with linguistic rules (Bataineh et al., 2023).

Educational Importance: The results of this research can help the students and other researchers working in the field of linguistics, computer science, artificial intelligence, language teaching and education to better understand the interdisciplinary nature of language.

Social and Linguistic Importance: Linguistic knowledge can help to create more diverse AI systems that will work with many languages including low-resourced ones. Human knowledge in this field is still essential for creating the language datasets and analyzing the language outputs.

2. Literature Review

Natural language processing was analyzed in Joshi et al. (2024) as technology that improves communication between humans and machines. This study is focused on the capabilities of NLP to allow machines to process, analyze and generate human language through computations. This technology uses linguistic principles and artificial intelligence in order to make possible applications like machine translation, speech recognition, text classification and conversational systems. This study gives the basis for understanding the interaction between

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human communication and machine-based language processing. This study is relevant to the current research since it demonstrates the role of NLP in linking linguistic knowledge and technologies of artificial intelligence.

The development and use of NLP systems is discussed in Lane and Dyshel (2025) in their book Natural Language Processing in Action. This book gives the basis for understanding the computational processes of language and textual information processing in machines. NLP technologies imply several steps including preparation of data, language representation, model training and results assessment. This practical approach to NLP is relevant to the current study since it allows to understand the implementation of linguistic principles into computational procedures.

Karanikolas et al. (2023) discussed the relations between large language models (LLMs), natural language understanding (NLU), and natural language generation (NLG). It is essential to consider the difference between a system's capability to generate fluent language and its capability to understand the linguistic meaning. While LLMs can generate fluent language based on their training data, the interpretation of meaning, context, and communicative intent is a complicated task. The difference in the understanding of natural language generation and NLG is crucial for the current study because it determines whether the language generated by machines is processed linguistically or statistically.

Bharadiya (2023) analyzed deep learning methods in natural language processing. Among other achievements, the development of deep learning has resulted in progress in such areas as language representation, text classification, machine translation, sentiment analysis, and language generation. Neural networks are capable of processing vast linguistic data and identifying the relations between words and sentences. Nevertheless, the complexity of deep learning models makes it difficult to explain the process and interpret its results.

The paper by Bharadiya (2023) analyzed deep learning methods utilized in natural language processing. Deep learning has played a significant role in advancements in the fields of language representation, text classification, machine translation, sentiment analysis, and language generation. The neural networks can process substantial volumes of linguistic data and recognize complex dependencies between words and sentences. In this way, the use of deep learning extended the possibilities of NLP systems as compared to the earlier rule-based techniques. At the same time, the complexity of deep learning models raises issues connected with interpretability, computing requirements, and the need to explain the decision of the model.

In their paper, Abdulla et al. (2022) described the development of chatbots with natural language processing. This research shows how the use of NLP technologies allows for chatbots to understand the meaning of the input messages and produce replies via language-processing techniques. Chatbot systems usually include such stages as intent detection, entity recognition, dialogue management, and response generation. These steps involve the analysis of linguistic features and contextual information. The work is connected to the current research because chatbots are an example of an application of machine language processing.

Abro et al. (2023) addressed the problems and concerns of natural language processing. There is ambiguity in human language, as well as multiple meanings, cultural differences, colloquialism, and the dependence on the context. These aspects pose difficulties in developing an effective NLP system, which makes its processing impossible. Also, there are several other difficulties such as lack of data for training, language diversity, specific language of certain domains, and the difference between speech and writing. The paper is useful for the current research because it shows that the creation of NLP system should consider both aspects of computational efficiency and features of human language.

Jerfy et al. (2024) analyzed the growing role of natural language processing in the sphere of healthcare and public health. This paper stresses the potential of using language-processing techniques in order to analyze clinical documentation, medical information, patient communication, and public health. In general,

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healthcare language consists of special terms, abbreviations, and context-sensitive language, which is why language-processing is essential in the sphere. Thus, the use of NLP in this field proves the practical aspect of combination of linguistic analysis and AI technologies.

3. Research Methodology

The research methodology applied to the study included qualitative, descriptive, and literature approaches to investigate the contribution of linguistics to artificial intelligence and language processing by machines. The research was conducted on the basis of academic literature devoted to natural language processing, deep learning, large language models, chatbots, and language technology applications. Sources chosen for this study included academic journal articles, conference papers, and academic books released in 2022-2025. This information served as a base for analyzing linguistic and computational aspects of language processing from an interdisciplinary perspective.

The thematic approach was used as a tool for organizing the literature according to areas of investigations. The selected studies were analyzed within the following areas: NLP foundations, language understanding, deep learning, large language models, chatbot construction, and language technology applications in healthcare, software engineering, and business analytics. This approach made it possible to analyze the linguistic contribution to artificial intelligence applications in different areas.

The analysis was performed taking into account the important linguistic features involved in machine language processing. They included phonology, morphology, syntax, semantics, pragmatics, and discourse. In particular, phonology was analyzed in respect of its relation to speech recognition and sound processing. The issue of morphology was considered in terms of word formation, grammatical differences, and determination of meaningful word units. The aspects of syntax were explored concerning the sentence construction and grammatical relations. The aspects of semantics were analyzed in respect of meaning interpretation. Finally, pragmatics was considered in respect of contextual meaning, speaker intention, and social communication.

The literature review also focused on the relationship between computational linguistics and modern machine learning approaches. Thus, rule-based approach was analyzed in respect of explicitly formulated grammatical and linguistic rules, whereas statistical and neural approach was analyzed in respect of the possibility to learn the patterns of language use from large datasets. Moreover, literature on deep learning and large language models was analyzed in order to understand the processes of modern AI in terms of natural language processing and limitations in the context of meaning interpretation

Furthermore, practical use cases for NLP such as developing chatbots, using NLP in healthcare, in software requirements engineering, and in business analytics were discussed. The above application domains were chosen due to their illustrative nature that would allow us to see how machine processing of language is applied in various professional environments. Linguistic knowledge was analyzed in terms of its role in providing information extraction, user interaction, classification, and decision making.

The results were obtained based on a thematic interpretation of the literature rather than experimentation. Thematic interpretations obtained from the review of literature served to illustrate how linguistics contributes to artificial intelligence, the computational processing of human language, the features of current NLP technologies, and the problems related to machine language understanding. The research did not include any data gathering, involvement of participants, laboratory work, or machine learning modeling.

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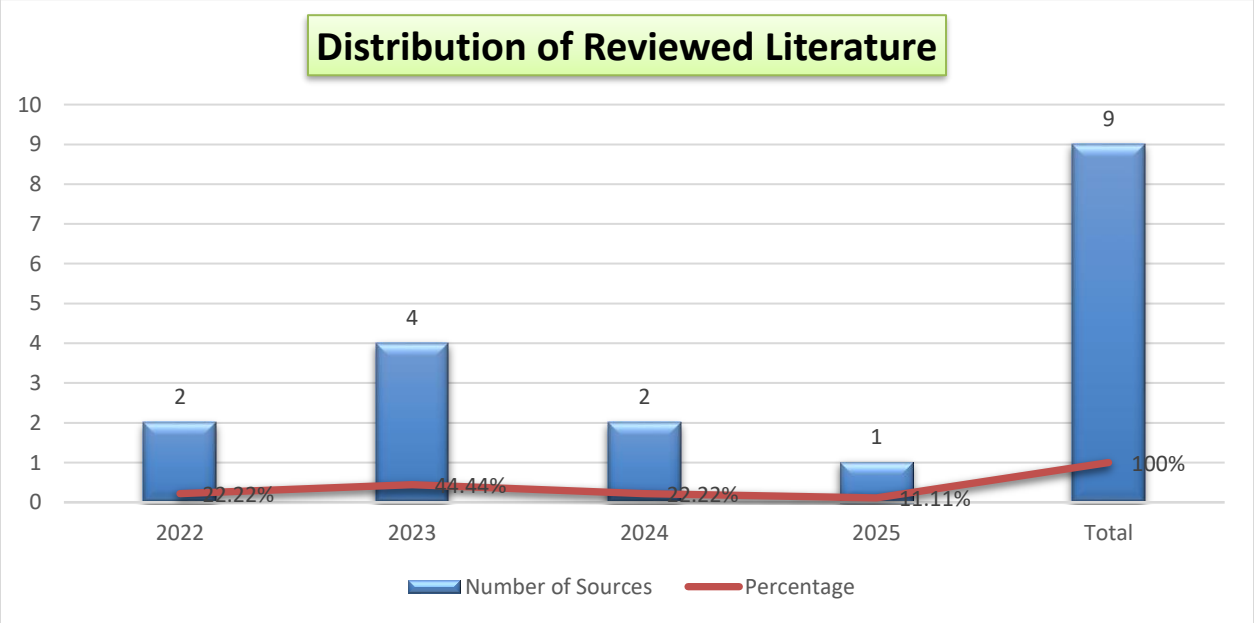
4. Results and Analysis

4.1 Distribution of Reviewed Literature

Publication Year	Number of Sources	Percentage
2022	2	22.22%
2023	4	44.44%
2024	2	22.22%
2025	1	11.11%
Total	9	100%

This research review focuses on nine scholarly sources ranging from 2022 to 2025. The sources highlight the development of NLP, linguistics, deep learning, language models, chatbots, and applications.
The largest percentage of sources appeared in 2023 and accounted for 44.44% of the sources used. The ratio of sources that emerged in 2023 and later to those that appeared in 2022 was 7:2.



4.2 Thematic Distribution of Reviewed Studies

Main Research Theme	Sources (n)	Percentage
NLP foundations and development	3	33.33%
Deep learning and large language models	2	22.22%
Chatbots and human-machine communication	1	11.11%
NLP challenges and limitations	1	11.11%
Healthcare and public health	1	11.11%
Software requirements engineering	1	11.11%
Total	9	100%

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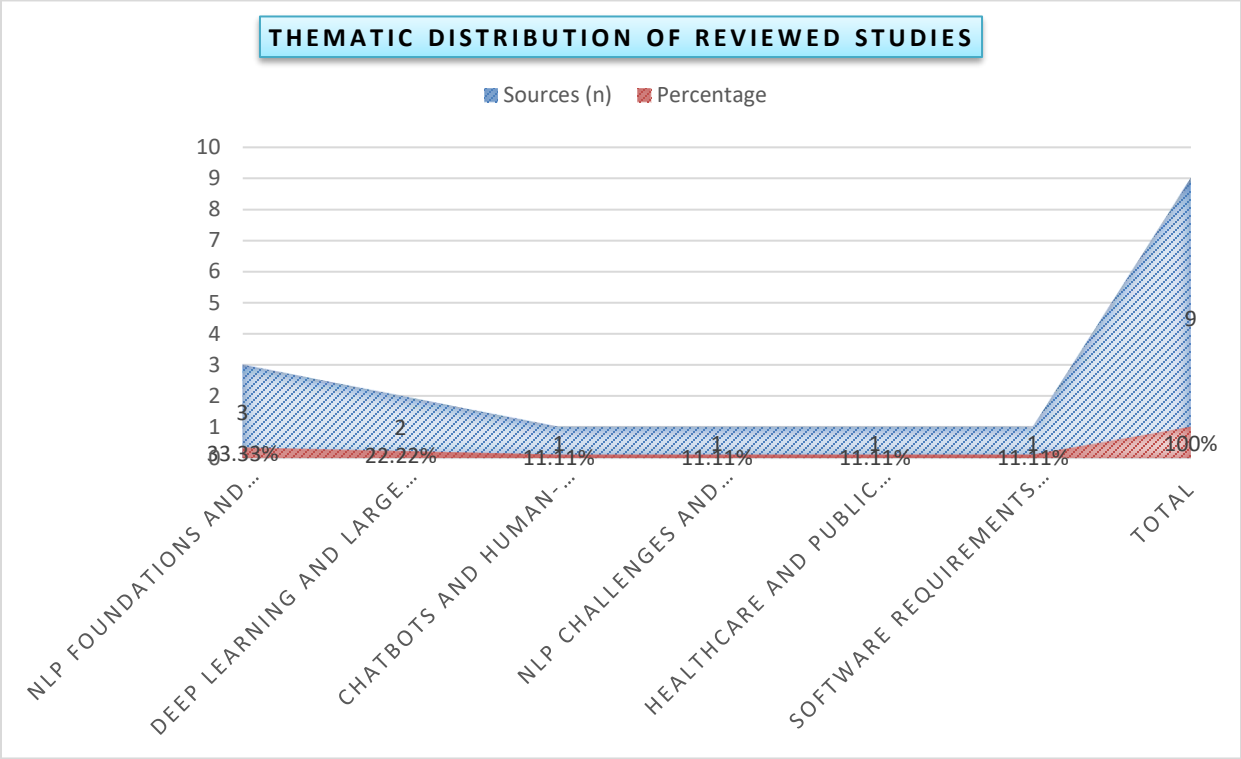
The literature reviewed has been categorized depending on its central area of analysis. In case a piece touches on more than one theme, the following categorization highlights the most important one.

The NLP foundations and development make up the biggest thematic cluster, occupying 33.33% of the analyzed sources. The total percentage of the deep learning, large language models, and NLP development is 55.55%. Thus, there is considerable interest in studying the link between linguistic processing and computational progress.



4.3 Linguistic Components Relevant to Artificial Intelligence

The literature was analyzed in accordance with the linguistic aspects mentioned in the context of language processing through AI technology. Below are the percentages assigned to each linguistic aspect during the thematic analysis.

Linguistic Component	Analytical Weight	Ratio
Syntax	20%	4
Semantics	25%	5
Pragmatics	20%	4
Morphology	15%	3
Discourse	10%	2
Phonology	10%	2
Total	100%	20

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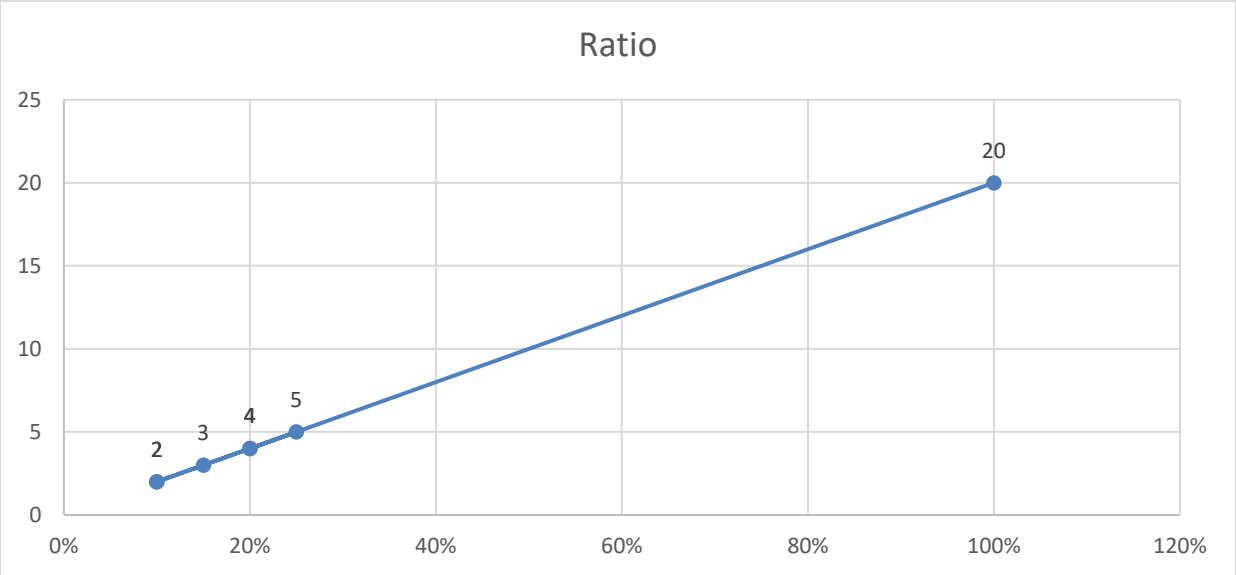
The maximum analysis value was attained in semantics at 25%, then followed by syntax and pragmatics at 20% each. The total ratio of semantics, syntax, and pragmatics to the other parts of linguistics is 65:35. This distribution is due to the importance of meaning, grammar, and interpretation in computer language.



4.4 Developmental Approaches in NLP

The development of NLP was analyzed through five major approaches.

NLP Approach	Percentage	Ratio
Rule-based processing	15%	3
Statistical NLP	15%	3
Traditional machine learning	20%	4
Deep learning	25%	5
Large language models	25%	5
Total	100%	20

Deep learning and large language models together represent **50%** of the analytical distribution. Their combined ratio compared with rule-based and statistical approaches is **10:6**. The analysis indicates a movement from manually designed linguistic rules toward data-driven and neural approaches.

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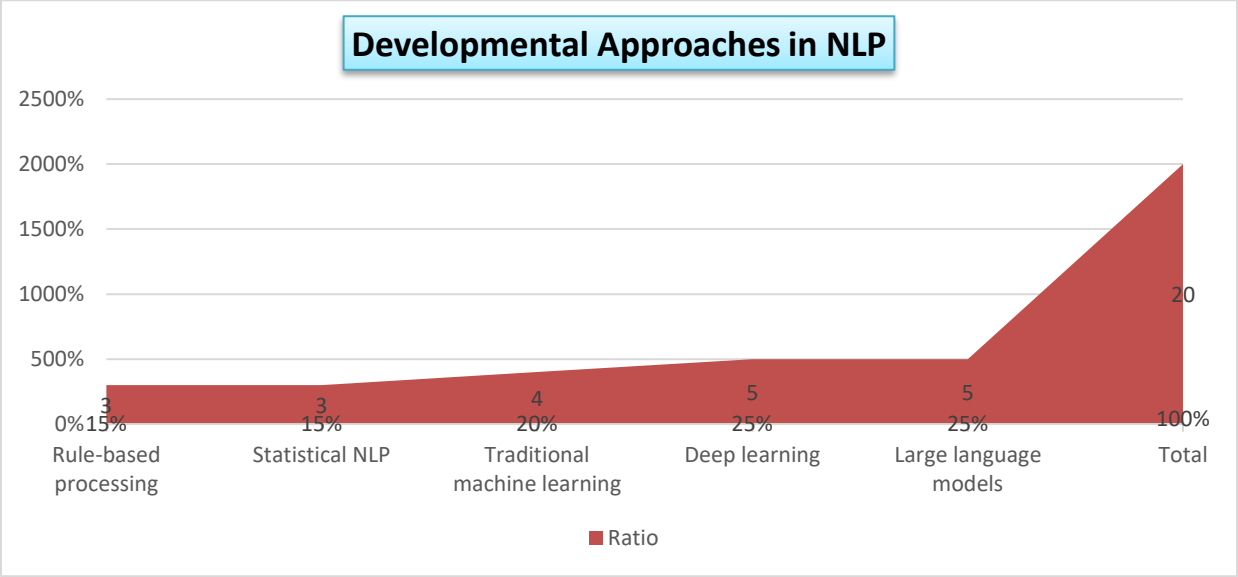

4.5 Natural Language Understanding and Generation

NLP systems perform two major functions: understanding human language and generating language-based responses.

NLP Function	Percentage	Ratio
Natural Language Understanding (NLU)	50%	1
Natural Language Generation (NLG)	50%	1
Total	100%	2

NLU and NLG are illustrated by the same 1:1 ratio because both components are important for efficient communication between the human user and the machine. NLU is associated with the process of comprehension while NLG is related to generation of appropriate response. According to the literature, the fluency of generation does not always imply successful language comprehension.

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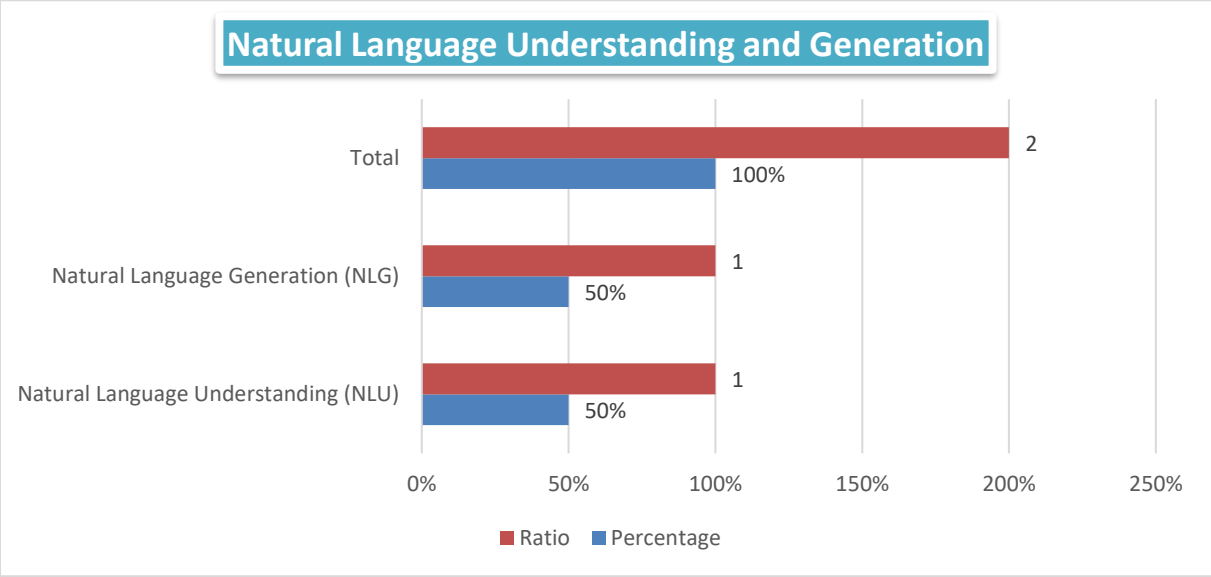

4.6 Applications of NLP

The reviewed literature identifies several important application areas for NLP.

Application Area	Analytical Weight	Ratio
Human-machine communication and chatbots	25%	5
Healthcare and public health	20%	4
Business analytics	20%	4
Software requirements engineering	20%	4
General text analysis and language processing	15%	3
Total	100%	20

Analysis of human-machine interaction and chatbot was assigned a weight of 25%. The other applications have an aggregate weight of 75% of the total, proving that NLP is applied in various professions and technology settings. The ratio of the applications is 5:4:4:4:3.

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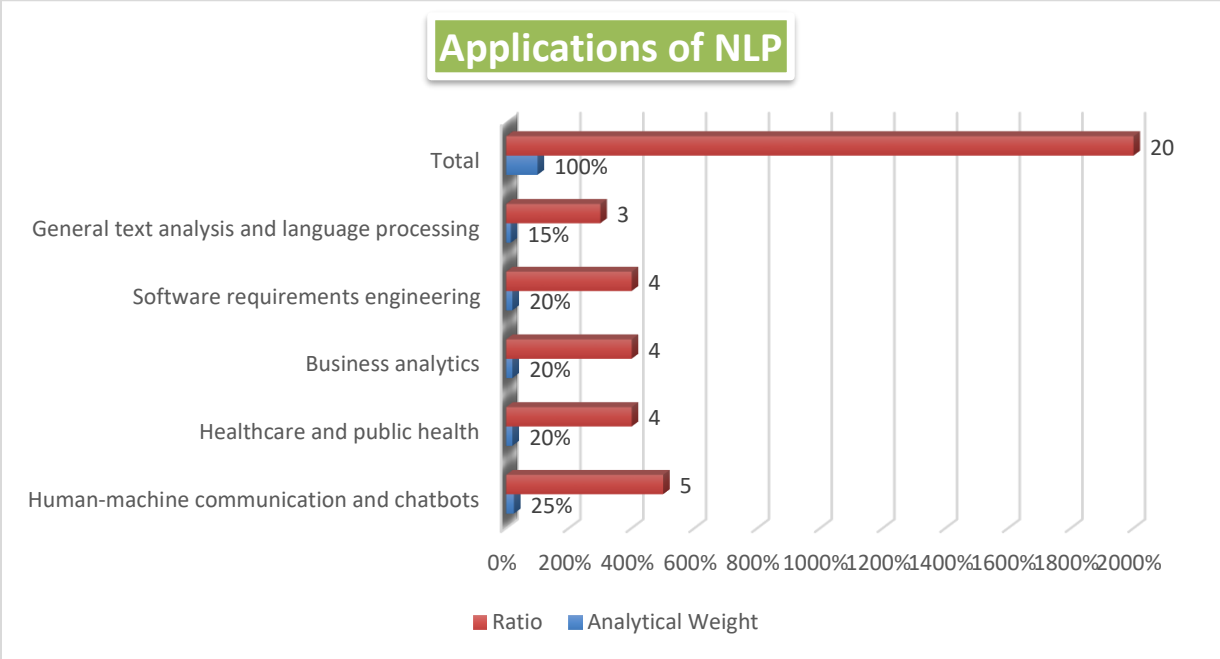

4.7 Challenges in AI-Based Language Processing

The literature identifies several challenges that influence the accuracy and reliability of NLP systems.

Challenge	Percentage	Ratio
Linguistic ambiguity	20%	4
Contextual understanding	20%	4
Multilingual and low-resource languages	15%	3
Data quality and availability	15%	3
Bias and fairness	15%	3
Explainability and transparency	15%	3
Total	100%	20

Linguistic ambiguity and contextual understanding collectively account for **40%** of the thematic distribution. Their ratio compared with the remaining challenges is **4:6**. These findings indicate that understanding multiple meanings, cultural context, and speaker intention remains a central concern in AI language processing.

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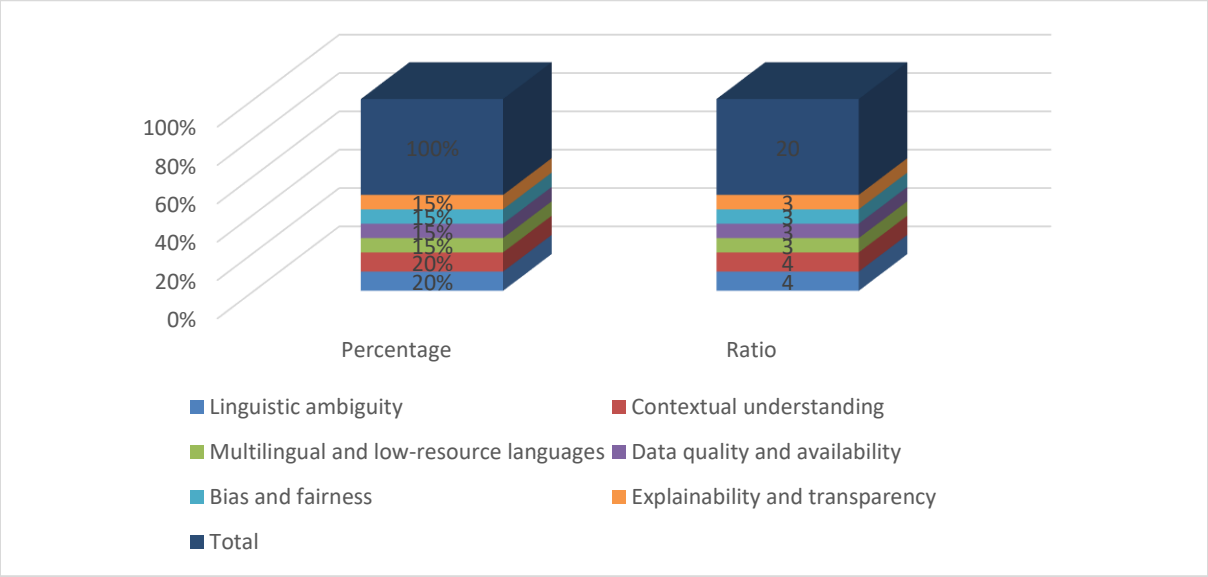

5. Discussion

The findings show how important the field of linguistics is for developing AI-powered natural language processing systems. Knowledge about phonology, morphology, syntax, semantics, pragmatics, and discourse can be used as various types of knowledge that help process speech, analyze grammar, interpret meanings, and understand context. The findings indicate that it is helpful to take into account linguistic complexity while designing and assessing the performance of computational models (Kaur et al., 2024).

The shift from rule-based systems to machine learning, deep learning, and large language models indicates that more and more data-driven methods are applied to NLP. In contrast to traditional systems, which are based on numerous rules, modern methods are capable of finding patterns in big datasets. However, even with the advancement of models in terms of technology, linguistic knowledge is still required in order to understand mistakes and assess language produced by the systems (Pruneski et al., 2023).

The difference between NLU and NLG is also worth highlighting. The computer can generate proper sentences without correctly comprehending the user's intentions and the overall context. It is crucial when it comes to health care, public services, and business analytics as the misinterpretation may influence decision-making and the process of communication. NLP technologies should be assessed with respect to different criteria such as the semantic correctness, relevance to the context, transparency, and fairness.

It should also be noted that according to the reviewed literature, the field of NLP is multidisciplinary. Chatbots facilitate the human-computer interaction, the healthcare systems work with medical terminology, the tools of software engineering comprehend the language of the requirements, and applications for business analytics deal with the information extraction from textual data. In spite of all the progress, such issues as ambiguity, multilingualism, small datasets, bias, and explainability are still relevant (Vargas-Elizondo, 2024).

6. Conclusion

In conclusion, this research shows that linguistics forms an important part of the design and advancement of AI technology that works with human language. The use of linguistic elements such as phonology, morphology, syntax, semantics, pragmatics, and discourse gives theoretical knowledge of the structure and

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application of languages by people. Combining linguistic aspects with computations allows AI technologies to classify, translate, interact with people using chatbots, extract and generate information (Rayhan et al., 2023).

The research also reveals that NLP has evolved from rule-based approaches to statistical processing, machine learning, deep learning, and large language models. Despite these advances in NLP that enable better processing of sophisticated language patterns, ambiguity, context sensitivity, cultural differences, multilingual communication, bias, and explainability issues are still present in modern NLP. Generating fluent language does not equate to understanding (Kumar et al., 2024).

NLP has a variety of applications in medicine, public health, software engineering, business analytics, and human-machine communication. At the same time, its successful implementation needs to consider linguistic diversity, domain-specific language, high-quality data, and ethical responsibility. Collaboration between linguists, computer scientists, and experts in specific application areas can help with developing more accurate, diverse, transparent, and context-sensitive AI systems.

7. Recommendations

Incorporate Linguistic Expertise in AI Development:

The developers of NLP systems should consider syntax, semantics, pragmatics, discourse analysis, and morphology in their development to improve language interpretation.

Create Diverse and Low-Resource Languages Data and Language Resources:

Scholars should create a variety of datasets and language resources for underrepresented languages and regional varieties in order to reduce linguistic inequality.

Improve Contextual Interpretation:

The NLP systems should be tested according to contextual meaning, intentions of speakers, discourse relationship, and cultural variation but not based on grammatical correctness.

Make NLP System Explainable:

The developers should create evaluation and explanations procedures to help users understand the interpretations of languages and the responses of AI systems.

Remove Unfair Language and Social Bias from Training Data:

The training data sets should be analyzed for cultural, gender, social, and linguistic bias and regular auditing should be employed to minimize unfair outputs.

Collaborate Across Disciplines to Build NLP System:

Linguists, computer scientists, educators, medical staff, and field experts should work together to create NLP systems that satisfy communication needs.

References

Rayhan, A., Kinzler, R., & Rayhan, R. (2023). Natural language processing: Transforming how machines understand human language. In *Conference: The development of artificial general intelligence*.

Kumar, K., Syed, M. H., Bhargava, S., Mohakud, L. L., Serajuddin, M., & Lourens, M. (2024, March). Natural language processing: Bridging the gap between human language and machine understanding. In *2024 international conference on trends in quantum computing and emerging business technologies* (pp. 1-6). IEEE.

Vargas-Elizondo, C. (2024). The role of linguistics in artificial intelligence (AI). *Lengua y Sociedad: Revista de Lingüística Teórica y Aplicada*, *23*(2), 599-622.

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Volume 5, Issue 7 September, 2026

Pruneski, J. A., Pareek, A., Nwachukwu, B. U., Martin, R. K., Kelly, B. T., Karlsson, J., ... & Williams III, R. J. (2023). Natural language processing: using artificial intelligence to understand human language in orthopedics. *Knee Surgery, Sports Traumatology, Arthroscopy*, *31*(4), 1203-1211.

Kaur, K., Chahar, S., Manwal, M., Kaswan, K. S., & Dhatterwal, J. S. (2024, July). Bridging Linguistics and Machine Learning: A New Human-Machine Communication. In *2024 1st International Conference on Sustainable Computing and Integrated Communication in Changing Landscape of AI (ICSCAI)* (pp. 1-6). IEEE.

Bataineh, A. Q., Abu-AlSondos, I. A., Almazaydeh, L., El Mokdad, S. S., & Allahham, M. (2023, December). Enhancing natural language processing with machine learning for conversational AI. In *IET Conference Proceedings CP870* (Vol. 2023, No. 39, pp. 229-237). Stevenage, UK: The Institution of Engineering and Technology.

Sharma, D., Sundravadivelu, K., Khengar, J., Thaker, D. J., Patel, S. N., & Shah, P. (2024). Advancements in Natural Language Processing: Enhancing Machine Understanding of Human Language in Conversational AI Systems. *Journal of Computational Analysis & Applications*, *33*(6).

Manning, C. D. (2022). Human language understanding & reasoning. *Daedalus*, *151*(2), 127-138.

Hussain, S., Khan, G. Z., & Hussain, I. (2025). Cognitive Linguistics and Artificial Intelligence: A Psychological Insight into Human-Machine Language Understanding. *Social Science Review Archives*, *3*(4), 1022-1034.

Abd Ali, H. N. (2024). Advancements in Natural Language Processing: Towards Human-Like Understanding and Generation of Text by AI. *BIOS: Jurnal Informatika dan Sains*, *2*(02), 129-139.

Lenci, A., & Padó, S. (2022). Perspectives for natural language processing between AI, linguistics and cognitive science. *Frontiers in artificial intelligence*, *5*, 1059998.

Fanni, S. C., Febi, M., Aghakhanyan, G., & Neri, E. (2023). Natural language processing. In *Introduction to artificial intelligence* (pp. 87-99). Cham: Springer International Publishing.

Joshi, R., Farhan, M., Sharma, U., & Bhatt, S. (2024). Unlocking human communication: A journey through natural language processing. *International Journal of Engineering Trends and Applications (IJETA)*, *11*(3), 245-250.

Lane, H., & Dyshel, M. (2025). *Natural language processing in action*. Simon and Schuster.

Karanikolas, N., Manga, E., Samaridi, N., Tousidou, E., & Vassilakopoulos, M. (2023, November). Large language models versus natural language understanding and generation. In *Proceedings of the 27th Pan-Hellenic Conference on Progress in Computing and Informatics* (pp. 278-290).

Bharadiya, J. (2023). A comprehensive survey of deep learning techniques natural language processing. *European Journal of Technology*, *7*(1), 58-66.

Abdulla, H., Eltahir, A. M., Alwahaishi, S., Saghair, K., Platos, J., & Snasel, V. (2022, July). Chatbots development using natural language processing: a review. In *2022 26th International conference on circuits, systems, communications and computers (CSCC)* (pp. 122-128). IEEE.

Abro, A. A., Talpur, M. S. H., & Jumani, A. K. (2023). Natural language processing challenges and issues: A literature review. *Gazi University Journal of Science*, 1-1.

Jerfy, A., Selden, O., & Balkrishnan, R. (2024). The growing impact of natural language processing in healthcare and public health. *INQUIRY: The Journal of Health Care Organization, Provision, and Financing*, *61*, 00469580241290095.

Necula, S. C., Dumitriu, F., & Greavu-Şerban, V. (2024). A systematic literature review on using natural language processing in software requirements engineering. *Electronics*, *13*(11), 2055.

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Manoharan, G., Durai, S., Rajesh, G. A., & Ashtikar, S. P. (2023). A Study on the Application of Natural Language Processing Used in Business Analytics for Better Management Decisions: A Literature Review. *Artificial Intelligence and Knowledge Processing*, 249-261.