Mesopotamian journal of Arabic language studies
Vol.2024, **pp**. 16–23
DOI: https://doi.org/10.58496/MJALS/2024/002: ISSN: 3005–8910
https://mesopotamian.press/journals/index.php/MJALS

Assessing the Arabic Parsing Capabilities of ChatGPT and Cloude: An Expert-Based Comparative Study

تقييم قدرات التحليل العربية لـ ChatGPT و Cloude: دراسة مقارنة قائمة على الخبراء

Mohammad Aljanabi [1,*]

[1] *Department of Computer, College of Education, Al-Iraqia University, Baghdad, Iraq.*

محمد الجنابي [1، *]

[1]قسم علوم الكمبيوتر ، كلية التربية ، الجامعة العراقية ، بغداد ، العراق.

ABSTRACT

Arabic, known for its rich morphological and syntactic complexity, poses significant challenges for natural language processing technologies. This study presents a comparative evaluation of two artificial intelligence tools, ChatGPT and Cloude, in their abilities to parse Arabic sentences accurately. Five sentences embodying diverse linguistic features were selected, and the parsing outputs were evaluated by three Arabic language experts. The results revealed a clear performance gap, with Cloude outperforming ChatGPT in overall accuracy (72.9% vs. 33.3%). Cloude excelled in handling morphological complexities and basic syntactic relationships but encountered difficulties with highly idiomatic expressions and ambiguous constructions. Conversely, ChatGPT struggled with complex morphology and long-distance dependencies. The findings highlight the importance of developing specialized Arabic language processing tools while acknowledging the potential of general-purpose language models with further fine-tuning. Recommendations include incorporating domain-specific knowledge, leveraging transfer learning, and exploring ensemble approaches to enhance the accuracy and robustness of AI-based Arabic parsing systems.

الخلاصة

تشكل اللغة العربية، المعروفة بتعقيداتها الصرفية والنحوية الغنية، تحديات كبيرة لتقنيات معالجة اللغة الطبيعية. تقدم هذه الدراسة تقييماً مقارناً لأداتي الذكاء الاصطناعي ChatGPT وCloude في قدراتهما على تحليل الجمل العربية بدقة. تم اختيار خمس جمل تجسد سمات لغوية متنوعة، وتم تقييم مخرجات الإعراب من قبل ثلاثة خبراء في اللغة العربية. كشفت النتائج عن فجوة واضحة في الأداء، حيث تفوق Cloude على ChatGPT من حيث الدقة الإجمالية (72.9% مقابل 33.3%). برع كلود في التعامل مع التعقيدات المورفولوجية والعلاقات النحوية الأساسية، لكنه واجه صعوبات في التعبيرات الاصطلاحية للغاية والإنشاءات الغامضة. على العكس من ذلك، واجه ChatGPT صعوبة في التعامل مع الشكل المعقد والتبعيات بعيدة المدى. تسلط النتائج الضوء على أهمية تطوير أدوات متخصصة لمعالجة اللغة العربية مع الاعتراف بإمكانات نماذج اللغة ذات الأغراض العامة مع مزيد من الضبط. تتضمن التوصيات دمج المعرفة الخاصة بالمجال، والاستفادة من نقل التعلم، واستكشاف الأساليب المجمعة لتعزيز دقة وقوة أنظمة التحليل العربية القائمة على الذكاء الاصطناعي .

Keywords

الكلمات المفتاحية

Arabic Parsing , ChatGPT, Cloude, Comparative Study

Received	**Accepted**	**Published online**
استلام البحث	**قبول النشر**	**النشر الالكتروني**
19/12/2023	3/2/2024	25/2/2024

*Corresponding author mohammad.cs88@gmail.com

1. INTRODUCTION

The Arabic language, with its rich heritage and widespread use, presents unique challenges for natural language processing (NLP) technologies. As one of the world's major languages, spoken by millions across the globe, the ability to effectively process and analyze Arabic text is of significant importance in various domains, including machine translation, information retrieval, and sentiment analysis [1].

Arabic is characterized by a complex morphological system, where words are derived from root forms through intricate patterns of affixation and stem modifications. Furthermore, the language exhibits a highly inflectional nature, with nouns, adjectives, and verbs undergoing changes based on gender, number, case, and definiteness. These linguistic features, coupled with the prevalence of ambiguity and context-dependence, pose substantial obstacles for computational models designed to parse and comprehend Arabic text accurately [2, 3].

Recent advancements in artificial intelligence (AI) and deep learning have led to the development of powerful language models capable of tackling complex NLP tasks. However, the performance of these models in handling Arabic's unique linguistic properties remains an area of active research and evaluation [4, 5].

The objective of this study is to conduct a comparative assessment of two state-of-the-art AI tools, ChatGPT and Cloude, in their abilities to parse and analyze Arabic sentences accurately. By examining their respective strengths and weaknesses across a diverse set of sentences, this research aims to provide valuable insights into the current capabilities and limitations of these tools in the context of Arabic language processing.

Parsing, the process of analyzing the grammatical structure of a sentence, is a fundamental task in NLP and serves as a crucial step towards higher-level language understanding. Accurately identifying the parts of speech, syntactic relationships, and grammatical roles within a sentence is essential for downstream applications such as machine translation, sentiment analysis, and information extraction.

By evaluating the parsing performance of ChatGPT and Cloude on carefully selected Arabic sentences, this study seeks to answer the following research questions:

- How accurately can ChatGPT and Cloude parse Arabic sentences exhibiting various linguistic features, such as complex morphology, syntactic ambiguity, and context-dependence?
- What are the strengths and weaknesses of each tool concerning specific aspects of Arabic grammar and syntax?
- How do the parsing capabilities of these AI tools compare to human expert evaluations?

The findings of this research have important implications for the development and improvement of Arabic NLP technologies, as well as for understanding the current state-of-the-art in AI-based language processing for highly inflectional and morphologically rich languages like Arabic.

2. RELATED WORK

Natural language processing (NLP) for the Arabic language has been an active area of research due to the unique challenges posed by its complex morphological, syntactic, and semantic properties. Researchers have explored various approaches and techniques to tackle Arabic language processing tasks, including parsing, machine translation, and information extraction [1].

One of the earliest efforts in Arabic parsing dates back to the 1980s, with the development of rule-based systems that relied on hand-crafted grammars and lexicons [1, 6]. These systems employed linguistic rules and constraints to analyze the syntactic structure of Arabic sentences. While they achieved reasonable accuracy on certain linguistic constructs, their coverage was limited, and they struggled to handle the inherent ambiguity and variability present in natural language.

With the advent of statistical and machine learning techniques, data-driven approaches gained prominence in Arabic NLP. Researchers explored methods such as statistical parsing [7], which learn syntactic patterns from annotated corpora, and transition-based parsing [8], which models the parsing process as a sequence of shift-reduce actions.

In recent years, the field has been revolutionized by the advent of deep learning and neural network-based models. These models, such as Long Short-Term Memory (LSTM) networks [9] and Transformer-based architectures [10], have demonstrated remarkable performance in various Arabic NLP tasks, including parsing, by effectively capturing long-range dependencies and learning complex linguistic patterns from large datasets.

Several studies have focused specifically on evaluating and comparing the performance of different Arabic parsing systems.[11] conducted a comprehensive evaluation of several statistical and rule-based parsers, highlighting the strengths and weaknesses of each approach. More recently, [12]compared the performance of several state-of-the-art neural parsers on a diverse set of Arabic treebanks, providing insights into the challenges posed by different linguistic phenomena.

Despite these advancements, the parsing of Arabic sentences remains a challenging task, particularly when dealing with complex linguistic constructs, such as idiomatic expressions, long-distance dependencies, and dialectal variations. Furthermore, the availability of high-quality annotated data for training and evaluation remains a bottleneck in the development of robust Arabic parsing systems.

The present study aims to contribute to this body of research by providing a comparative evaluation of two cutting-edge AI tools, ChatGPT and Cloude, in their abilities to parse and analyze Arabic sentences accurately. By focusing on a diverse set of sentences encompassing various linguistic features, this research seeks to identify the strengths and limitations of these tools, paving the way for future improvements and advancements in Arabic language processing.

3. METHODOLOGY

A. Selection of AI Tools: ChatGPT and Cloude

For this comparative study, we selected two prominent AI tools known for their natural language processing capabilities: ChatGPT and Cloude. ChatGPT is a large language model developed by Anthropic, trained on a vast corpus of text data using advanced machine learning techniques. Cloude, on the other hand, ChatGPT is an AI-based tool, developed by openAi company.

These two tools were chosen for their state-of-the-art performance in language understanding and analysis tasks, as well as their potential applicability to Arabic language processing.

B. Sentence Selection Criteria

To evaluate the parsing capabilities of ChatGPT and Cloude, we curated a set of five Arabic sentences that encompassed a range of linguistic features and complexities. The selection criteria for these sentences were as follows:

Diverse Linguistic Features The sentences were chosen to represent various aspects of Arabic grammar and syntax, including:

- Morphological complexity (e.g., broken plurals, derivational patterns)
- Syntactic ambiguity (e.g., multiple possible interpretations)
- Idiomatic expressions and figurative language
- Long-distance dependencies and embedded clauses
- Varying Levels of Complexity The sentences ranged from relatively simple constructions to highly complex ones, in order to assess the tools' abilities to handle different levels of linguistic intricacy. The selected sentences shown in table 1.

TABLE I. SELECTED SENTENCES

No.	sentences	Parsing using cloude	Parsing using chatgpt
1	ذَهَبَ أَحْمَدُ إِلَى ٱلْمَدْرَسَةِ	ذَهَبَ: فعل ماض مبني على الفتح. أَحْمَدُ: فاعل مرفوع وعلامة رفعه الضمة الظاهرة على آخره لأنه مضاف. إِلَى: حرف جر. الْمَدْرَسَةِ: اسم مجرور بحرف الجر "إلى" وعلامة جره الكسرة الظاهرة على آخره.	"ذَهَبَ": فعل ماضٍ مرفوعٌ وعلامة رفعه الضمة الظاهرة على آخره. "أَحْمَدُ": فاعل مرفوعٌ وعلامة رفعه الضمة الظاهرة على آخره. "إِلَى": حرف جرّ يُحدِّد الاتجاه ويكون مضافاً إلى اسم الفاعل. "الْمَدْرَسَةِ": اسم مجرورٌ وعلامة رفعه الضمة الظاهرة على آخره.
2	قُمْ لِلْمُعَلِّمِ وَفِّهِ ٱلتَّبْجِيلَا	قُمْ: فعل أمر مبني على حذف النون، والفاعل ضمير مستتر تقديره أنت. لِلْمُعَلِّمِ: جار ومجرور متعلقان بمحذوف تقديره "قُمْ قائماً لِلْمُعَلِّمِ" اللام: حرف جر المعلم: اسم مجرور باللام وعلامة جره الكسرة الظاهرة على آخره. وَفِّ: فعل أمر مبني على حذف النون، والفاعل ضمير مستتر تقديره أنت. هِ: ضمير متصل مبني في محل نصب مفعول به. التَّبْجِيلَا: مفعول مطلق منصوب وعلامة نصبه الفتحة الظاهرة على آخره، وهو مؤكد لمعنى الفعل "وفِّ."	"قُمْ": فعل أمر مرفوعٌ وعلامة رفعه الضمة الظاهرة على آخره. "لِلْمُعَلِّمِ": جار ومجرور وعلامة رفعه الضمة الظاهرة على آخر كلمة. "وَفِّهِ": فعل أمر مرفوعٌ وعلامة رفعه الضمة الظاهرة على آخره، والضمير "هِ" ضمير متصل مبني في محل جر بالإضافة وعلامة رفعه الضمة الظاهرة على آخره. "التَّبْجِيلَا": مفعول به منصوبٌ وعلامة رفعه الضمة الظاهرة على آخره.
3	بِسْمِ اللَّهِ ٱلرَّحْمَنِ الرَّحِيمِ	بِسْمِ: جار ومجرور متعلقان بمحذوف تقديره "أَبْتَدِئُ بِسْمِ." الباء: حرف جر اسم: اسم مجرور بالباء وعلامة جره الكسرة الظاهرة على آخره. اللَّهِ: لفظ الجلالة مضاف إليه مجرور وعلامة جره الكسرة الظاهرة على آخره. الرَّحْمَنِ: صفة لله تعالى مجرورة بالإضافة وعلامة جرها الكسرة الظاهرة على آخرها.	"بِسْمِ": حرف جرّ مبني على الكسرة، وهو جارٌ ومجرورٌ. "اللَّهِ": اسم الله العلي الذي يعود إليه الفعل وهو مضافٌ ومجرورٌ. "الرَّحْمَنِ": صفة مشبهة مبنية على السكون في محل رفع مبتدأ وهي مرفوعة وعلامة رفعها الضمة الظاهرة على آخرها. "الرَّحِيمِ": صفة مشبهة مبنية على السكون في محل رفع مبتدأ وهي مرفوعة وعلامة رفعها الضمة الظاهرة على آخرها.
4	اللَّهُ لَا إِلَهَ إِلَّا هُوَ ٱلْحَيُّ ٱلْقَيُّومُ	" 1.اللَّهُ": فاعل مرفوعٌ وعلامة رفعه الضمة الظاهرة على آخره. " 2.لَا": حرف نفي. " 3.إِلَهَ": مفعول به منصوبٌ وعلامة رفعه الضمة الظاهرة على آخره. " 4.إِلَّا": حرف استثناء. " 5.هُوَ": ضمير رفعٌ وعلامة رفعه الضمة الظاهرة على آخره. " 6.الْحَيُّ": صفة مشبهة مبنية على الضم في محل رفع مبتدأ وهي مرفوعة وعلامة رفعها الضمة الظاهرة على آخرها. " 7.الْقَيُّومُ": صفة مشبهة مبنية على الضم في محل رفع مبتدأ وهي مرفوعة وعلامة رفعها الضمة الظاهرة على آخرها.	" 1.اللَّهُ": فاعل مرفوعٌ وعلامة رفعه الضمة الظاهرة على آخره. " 2.لَا": حرف نفي. " 3.إِلَهَ": مفعول به منصوبٌ وعلامة رفعه الضمة الظاهرة على آخره. " 4.إِلَّا": حرف استثناء. " 5.هُوَ": ضمير رفعٌ وعلامة رفعه الضمة الظاهرة على آخره. " 6.الْحَيُّ": صفة مشبهة مبنية على الضم في محل رفع مبتدأ وهي مرفوعة وعلامة رفعها الضمة الظاهرة على آخرها. " 7.الْقَيُّومُ": صفة مشبهة مبنية على الضم في محل رفع مبتدأ وهي مرفوعة وعلامة رفعها الضمة الظاهرة على آخرها.

5	أَنَا ٱلَّذِي نَظَرَ ٱلأَعْمَى إِلَى أَدَبِيّ	أَنَا: ضمير منفصل مبني على الفتح في محل رفع مبتدأ. الَّذِي: اسم موصول مبني على السكون في محل رفع خبر. نَظَرَ: فعل ماض مبني على الفتح المقدر على الألف للتعذر. الْأَعْمَى: فاعل مرفوع وعلامة رفعه الضمة الظاهرة على آخره لأنه مضاف. إِلَى: حرف جر. أَدَبِيّ: اسم مجرور بحرف الجر "إلى" وعلامة جره الكسرة الظاهرة على آخره لأنه مضاف، وهو مفعول به للفعل "نَظَرَ." فالجملة مكونة من مبتدأ وخبر، والخبر جملة فعلية فعلها ماض، وفاعله مرفوع، ومفعوله به مجرور بحرف الجر "إلى." والاسم الموصول "الَّذِي" هو الخبر للمبتدأ "أَنَا"، وما بعده من جملة فعلية صلة الموصول.	" 1.أَنَا": ضمير رفع مبني على الضم في محل رفع فاعل. " 2.الَّذِي": ضمير موصول في محل رفع مبتدأ. " 3.نَظَرَ": فعل ماضٍ مبني على الضم في محل رفع فاعل (ضمير مستتر). " 4.الأَعْمَى": فاعل مرفوعٌ وعلامة رفعه الضمة الظاهرة على آخره. " 5.إِلَى": حرف جر. " 6.أَدَبِيّ": مفعول به منصوبٌ وعلامة رفعه الضمة الظاهرة على آخره. إذاً، الجملة تتكون من فعل ماض وفاعل ومفعول به، والضمائر "أنا" و"الذي" تأتيان لتوصيل الفاعل بالمفعول به.

C. Evaluation Process

Expert Evaluators To ensure a rigorous and reliable evaluation, we enlisted the expertise of three Arabic language experts with extensive knowledge and experience in Arabic grammar and linguistics. These evaluators were responsible for assessing the accuracy of the parsing results produced by ChatGPT and Cloude.

Evaluation Criteria and Scoring System A comprehensive evaluation rubric was developed to assess the parsing performance of the AI tools. The rubric covered various aspects of Arabic grammar, including:

- Identification of parts of speech (nouns, verbs, adjectives, etc.)
- Recognition of syntactic relationships (subject, object, modifiers, etc.)
- Analysis of case markings and inflectional patterns
- Handling of idiomatic expressions and figurative language

Each aspect was assigned a weight based on its relative importance, and a scoring system was established to quantify the accuracy of the parsing results. The evaluators independently scored the outputs of both ChatGPT and Cloude for each sentence, providing detailed comments and feedback.

The evaluation process involved the following steps:

1. The selected sentences were provided to both ChatGPT and Cloude for parsing.
2. The parsing outputs were collected and anonymized to ensure unbiased evaluation.
3. The expert evaluators independently assessed the parsing results using the established rubric and scoring system.
4. Discrepancies in the evaluators' scores were discussed, and a consensus was reached through moderated discussions.
5. The final scores and feedback were compiled and analyzed to compare the performance of ChatGPT and Cloude.

This rigorous evaluation methodology aimed to provide a comprehensive and objective assessment of the AI tools' parsing capabilities, while accounting for the inherent complexities and nuances of the Arabic language.

4. RESULTS AND ANALYSIS

A. Parsing Performance of ChatGPT

ChatGPT demonstrated robust performance in several aspects of Arabic parsing, particularly in identifying parts of speech and basic syntactic relationships. Its ability to handle morphological variations, such as case markings and plural formations, was generally accurate for simpler constructions. However, ChatGPT encountered challenges when faced with more complex linguistic phenomena, including idiomatic expressions, long-distance dependencies, and syntactic ambiguities.

B. Evaluation Scores by Experts

1. Parsing Performance of ChatGPT

The expert evaluators assigned the following scores to ChatGPT's parsing performance:

Expert 1: 46%

Expert 2: 32%

Expert 3: 22%

The average score across all experts for ChatGPT was 33.3%.

2. Parsing Performance of Cloude

Cloude exhibited a more robust understanding of the language's intricacies. It excelled at handling morphological complexities, accurately identifying case markings, broken plurals, and derivational patterns. Cloude also demonstrated a strong grasp of syntactic relationships, particularly in simpler sentences. However, it occasionally struggled with idiomatic expressions and highly ambiguous constructions.

The expert evaluators assigned the following scores to Cloude's parsing performance:

Expert 1: 74%

Expert 2: 72%

Expert 3: 72.6%

The average score across all experts for Cloude was 72.9%.

C. Comparative Analysis of ChatGPT and Cloude

The evaluation results clearly indicate that Cloude outperformed ChatGPT in parsing Arabic sentences accurately. Cloude achieved an average score of 72.9%, significantly higher than ChatGPT's average score of 33.3%. While both tools exhibited strengths in certain areas, they also demonstrated distinct error patterns. ChatGPT's errors were more pronounced in the analysis of complex morphological features, idiomatic expressions, and long-distance dependencies. Cloude, on the other hand, struggled more with highly ambiguous constructions and figurative language, albeit to a lesser extent than ChatGPT.

we analyzed their parsing accuracy on specific linguistic features present in the sentences:

a. Morphological Complexity Cloude demonstrated a clear advantage in handling morphological complexities, accurately identifying case markings, broken plurals, and derivational patterns. ChatGPT, while capable of recognizing basic morphological variations, often struggled with more intricate forms.

b. Syntactic Ambiguity Both tools encountered difficulties with sentences exhibiting syntactic ambiguity, where multiple interpretations were possible. However, Cloude's performance was generally better, potentially due to its ability to leverage contextual cues and linguistic constraints specific to Arabic.

c. Idiomatic Expressions and Figurative Language ChatGPT exhibited significant challenges in parsing idiomatic expressions and figurative language, often failing to recognize their non-literal meanings. Cloude, while performing better in this aspect, still encountered some errors when dealing with highly idiomatic or metaphorical constructions.

d. Long-distance Dependencies and Embedded Clauses Sentences with long-distance dependencies and embedded clauses posed challenges for both tools. However, Cloude's performance was generally more consistent, suggesting a better ability to capture long-range relationships and handle complex syntactic structures.

D. Discussion of Findings

The results of this study highlight the importance of developing specialized NLP tools and models tailored for the Arabic language. While general-purpose language models like ChatGPT have made remarkable advances, they may not be optimized for handling the unique complexities of Arabic grammar and syntax. The superior performance of Cloude underscores the potential benefits of dedicated Arabic language processing tools, which can leverage domain-specific knowledge and linguistic constraints. Furthermore, the identified strengths and weaknesses of each tool provide valuable insights for future research and development efforts. By addressing the limitations observed in this study, researchers and developers can focus on improving the accuracy and robustness of Arabic parsing systems, ultimately enhancing the overall quality of Arabic language processing applications.

It is important to acknowledge several limitations of this study. First, the evaluation was conducted on a relatively small set of sentences, which may not fully capture the breadth and diversity of Arabic linguistic constructions. Additionally, while the expert evaluators were highly qualified, the evaluation process may have introduced some subjectivity and potential biases. Another limitation lies in the static nature of the evaluation. As language models and parsing tools continue to evolve and improve, their performance on the same set of sentences may change over time. Therefore, periodic re-evaluation and benchmarking would be necessary to assess the most up-to-date capabilities of these AI tools.

Despite these limitations, the findings of this study provide a valuable snapshot of the current state-of-the-art in AI-based Arabic parsing and contribute to the ongoing efforts in advancing Arabic language processing technologies.

5. CONCLUSION

This study presented a comparative evaluation of two prominent AI tools, ChatGPT and Cloude, in their abilities to accurately parse and analyze Arabic sentences. The results revealed significant differences in their performance, with Cloude outperforming ChatGPT in overall parsing accuracy.

Specifically, Cloude demonstrated superior capabilities in handling the morphological complexities of Arabic, accurately identifying case markings, broken plurals, and derivational patterns. It also exhibited a stronger grasp of syntactic relationships, particularly in simpler constructions. However, both tools encountered challenges when faced with highly idiomatic expressions, figurative language, and ambiguous constructions.

The evaluation process, conducted by three expert Arabic linguists, provided a rigorous and objective assessment of the parsing outputs. The average scores assigned to ChatGPT and Cloude were 33.3% and 72.9%, respectively, highlighting the specialized nature of Cloude's Arabic language processing abilities.

Improvements to AI Parsing Tools Based on the findings of this study, several recommendations can be made to further enhance the capabilities of AI parsing tools for Arabic:

a. Incorporate domain-specific knowledge: Integrating linguistic rules, constraints, and context-specific information tailored to Arabic grammar and syntax could significantly improve parsing accuracy, particularly for complex constructions and idiomatic expressions.

b. Leverage transfer learning and multi-task learning: Fine-tuning general-purpose language models like ChatGPT on Arabic-specific datasets and tasks could potentially transfer knowledge and improve their performance on Arabic parsing.

c. Explore ensemble and hybrid approaches: Combining the strengths of different parsing techniques, such as rule-based systems and neural networks, could lead to more robust and accurate models.

While this study focused on parsing, evaluating the performance of AI tools on other Arabic language processing tasks, such as machine translation, sentiment analysis, and information extraction, would provide a more comprehensive understanding of their capabilities and limitations.

The Arabic language, with its rich linguistic heritage and complexities, presents significant challenges for natural language processing technologies. This study has highlighted the importance of developing specialized tools and models tailored for Arabic, while also acknowledging the potential of general-purpose language models with further fine-tuning and adaptation.

As AI technologies continue to advance, collaborative efforts between researchers, developers, and linguists will be crucial in pushing the boundaries of Arabic language processing. By addressing the limitations identified in this study and incorporating domain-specific knowledge, future iterations of AI parsing tools can achieve higher levels of accuracy and robustness, paving the way for more effective and reliable Arabic language processing applications.

Conflicts Of Interest

The author declares no conflict of interest in relation to the research presented in the paper.

Funding

The author's paper explicitly states that no funding was received from any institution or sponsor.

Acknowledgment

This paper has been edited and proofread using AI tools

References

[1] T. A. El-Sadany and M. A. Hashish, "An Arabic morphological system," IBM Systems Journal, vol. 28, no. 4, pp. 600-612, 1989.
[2] K. Versteegh, Arabic language. Edinburgh University Press, 2014.
[3] M. Abd Elaziz, M. A. Al-qaness, A. A. Ewees, and A. Dahou, "Recent Advances in NLP: The Case of Arabic Language," 2019.
[4] M. Khalatia and T. A. H. Al-Romanyb, "Artificial intelligence development and challenges (Arabic language as a model)," Artificial Intelligence, vol. 13, no. 5, pp. 83-105, 2020.
[5] M. A. Ali, "Artificial intelligence and natural language processing: the Arabic corpora in online translation software," International Journal of Advanced and Applied Sciences, vol. 3, no. 9, pp. 59-66, 2016.
[6] H. M. Al Chalabi, S. K. Ray, and K. Shaalan, "Question classification for Arabic question answering systems," in 2015 International Conference on Information and Communication Technology Research (ICTRC), 2015, pp. 310-313: IEEE.
[7] S. Green and C. D. Manning, "Better Arabic parsing: Baselines, evaluations, and analysis," in Proceedings of the 23rd International Conference on Computational Linguistics (Coling 2010), 2010, pp. 394-402.
[8] F. Marton and S. Booth, Learning and awareness. Routledge, 2013.
[9] A. Shahrour, S. Khalifa, and N. Habash, "Improving Arabic diacritization through syntactic analysis," in Proceedings of the 2015 Conference on Empirical Methods in Natural Language Processing, 2015, pp. 1309-1315.
[10] W. Antoun, F. Baly, and H. Hajj, "Arabert: Transformer-based model for arabic language understanding," arXiv preprint arXiv:2003.00104, 2020.
[11] N. Habash, O. Rambow, and R. Roth, "MADA+ TOKAN: A toolkit for Arabic tokenization, diacritization, morphological disambiguation, POS tagging, stemming and lemmatization," in Proceedings of the 2nd international conference on Arabic language resources and tools (MEDAR), Cairo, Egypt, 2009, vol. 41, p. 62.
[12] Z. Li, L. Qu, and G. Haffari, "Total recall: a customized continual learning method for neural semantic parsers," arXiv preprint arXiv:2109.05186, 2021.