

BAREC Demo: Resources and Tools for Sentence-level Arabic Readability Assessment

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Abstract

We present BAREC Demo, a web-based system for fine-grained, sentence-level Arabic readability assessment. The demo is part of the Balanced Arabic Readability Evaluation Corpus (BAREC) project, which manually annotated 69,000 sentences (over one million words) from diverse genres and domains using a 19-level readability scale inspired by the Taha/Arabi21 framework, covering reading abilities from kindergarten to postgraduate levels. The project also developed models for automatic readability assessment. The demo provides two main functionalities for educators, content creators, language learners, and researchers: (1) a Search interface to explore the annotated dataset for text selection and resource development, and (2) an Analyze interface, which uses trained models to assign detailed readability labels to Arabic texts at the sentence level. The system and all of its resources are accessible at <https://barec.camel-lab.com>.

1 Introduction

Text readability refers to the degree to which a written text is easy to read and understand, based on linguistic and structural features such as vocabulary, syntax, and sentence complexity. It reflects how well a text aligns with the reader’s proficiency, influencing comprehension, reading speed, retention, and engagement. This is especially critical in educational and language learning contexts, where matching texts to learners’ reading levels can significantly enhance learning outcomes (DuBay, 2004).

Assessing the readability of Arabic text poses significant challenges due to its rich morphology, complex syntax, and ambiguous orthography (owing to optional diacritics), as well as the diglossic landscape of Modern Standard Arabic (MSA) and diverse dialects (Ferguson, 1959; Habash, 2010; Obeid et al., 2020). Existing readability efforts vary in focus on document-level sentence-level, or word-level measures, but with generally limited support

for diverse text genres (Alhafni et al., 2024; Niraula et al., 2014; Hazim et al., 2022; Jiang et al., 2020). This leaves a critical need for tools that can provide fine-grained, sentence-level assessment, which is essential for precise content adaptation.

To address these issues, the Balanced Arabic Readability Evaluation Corpus (BAREC) (Elmadani et al., 2025) aims to bring fine-grained readability assessment to the sentence level. By focusing on sentences and shorter text segments rather than the entire text, we gain more control and granularity in modeling text difficulty, enabling new applications, such as detailed readability feedback and metrics for automated text simplification. BAREC provides fine-grained, sentence-level readability annotations across 19 distinct levels, from kindergarten to postgraduate comprehension (Taha-Thomure, 2017; Habash et al., 2025).

In this paper, we present the BAREC demo, a robust web-based platform developed under the BAREC project. The demo integrates two powerful and complementary tools: **Search** is a browser providing access through the manually annotated 69K sentences (1M words) in the BAREC corpus, and **Analyze** is an automated readability assessment system, leveraging the machine learning techniques trained on the BAREC corpus (Elmadani et al., 2025). The BAREC demo target audience includes educators, language learners, content creators, and researchers interested in Arabic NLP and education. The system and all of its resources are publicly accessible.^{1,2,3,4,5}

Next we present related work (§2), introduce BAREC resources and tools (§3), outline system design (§4), illustrate usage with examples (§5), and report on a brief evaluation (§6).

¹Project Resources: <https://barec.camel-lab.com>

²Search: <https://barec.vercel.app/en/search>

³Analyze: <https://barec.vercel.app/en/analyze>

⁴Video: <https://barec.camel-lab.com/emnlp-demo>

⁵Licenses: Code is MIT and Data is CC-BY-SA-4.0.

2 Background & Related Work

2.1 Arabic Readability Challenges

Assessing readability in Arabic is especially difficult due to the language’s linguistic complexity. Its rich morphology leads to extensive lexical variation, complicating vocabulary assessment across topics and dialects. The diglossic split between Modern Standard Arabic and regional varieties adds further difficulty, particularly for less proficient readers. Orthographic features, such as the optional use of diacritics, can significantly alter meaning and pronunciation, affecting comprehension. Arabic’s flexible syntax also makes it hard to estimate sentence-level difficulty using simple metrics like word counts or n-grams. These challenges require advanced preprocessing for consistent manual annotation and robust modeling for accurate automatic assessment. The BAREC project addresses these issues through tailored guidelines, a carefully annotated corpus, and tools designed for fine-grained sentence-level analysis.

2.2 Existing Arabic Readability Efforts

In the context of Arabic, there were several significant efforts to define, annotate and model text readability levels. BAREC draws on the Taha/Arabi21 framework (Taha-Thomure, 2017), which introduced a 19-level system for book-level text leveling widely used in children’s literature. The SAMER project (Al Khalil et al., 2017) developed a Google Docs add-on for word-level readability visualization and substitution (Hazim et al., 2022) as well as a readability leveled Arabic thesaurus interface (Al Khalil et al., 2018; Jiang et al., 2020). Arabic CEFR-aligned initiatives include KELLY (Kilgarriff et al., 2014), ZAEBUC (Habash and Palfreyman, 2022), ReadMe++ (Naous et al., 2023), and the Arabic Vocabulary Profile Project (Soliman and Familiar, 2024). Automatic readability efforts range from formula-based systems like AARI (Al Tamimi et al., 2014) and OSMAN (El-Haj and Rayson, 2016) to ML-based approaches using linguistic features (Forsyth, 2014; Saddiki et al., 2018) or annotated data (Liberato et al., 2024).

BAREC advances upon these efforts by creating a large, sentence-level, manually annotated corpus with 19 readability levels across genres, and training automatic readability models on it (Habash et al., 2025; Elmadani et al., 2025)

3-3	5-5	7-7	ق qaf-19			
			ص sad-18			
	5-4	7-6	ف fa-17			
			ع ayn-16			
3-2	5-3	7-5	س sin-15			
			ن nun-14			
3-1	5-2	7-4	م mim-13			
			ل lam-12			
		5-1	7-3	ي ya-10	ك kaf-11	
	ح ha-8			ط ta-9		
	7-2		ه ha-5	و waw-6	ز zay-7	
		7-1	ا alif-1	ب ba-2	ج jim-3	د dal-4
BAREC-3	BAREC-5	BAREC-7	BAREC-19 Levels			

Figure 1: The BAREC Pyramid illustrates the BAREC levels and three collapsed variants.

3 BAREC Resources & Tools

The BAREC project provides resources to help educational writers tailor texts to their audience through readability assessment. The current demo highlights two key components: a search interface for exploring the large annotated corpus, and an AI module that predicts sentence-level readability.

3.1 BAREC Corpus

The BAREC corpus (Habash et al., 2025; Elmadani et al., 2025) is a large-scale Arabic readability dataset containing over 69 thousand sentences (comprising 1 million words) with sentence-level annotations across 19 readability levels. The BAREC pyramid (Figure 1) illustrates the scaffolding of these levels, and three collapsed versions of level size 7, 5, and 3. The corpus spans a wide educational range and diverse topics, compiled from 1,922 documents manually categorized into three domains: **Arts & Humanities**, **Social Sciences**, and **STEM**, and three readership groups: **Foundational**, **Advanced**, and **Specialized**. Texts were sourced from 30 different resources, all selected to comply with copyright restrictions. Approximately 25% of the sentences were manually transcribed from previously unavailable sources.

3.2 BAREC AI Component

The AI component of the BAREC demo website is designed to predict the readability level of a given sentence. For this, we fine-tune AraBERTv02 (Antoun et al., 2020) on the BAREC corpus using cross-entropy loss (CE), following the AraBERTv02+Word+CE configuration from Elmadani et al. (2025), and implement it with the Transformers library (Wolf et al., 2019). This configuration performs the best among the setups that do not require any data pre-processing. Model

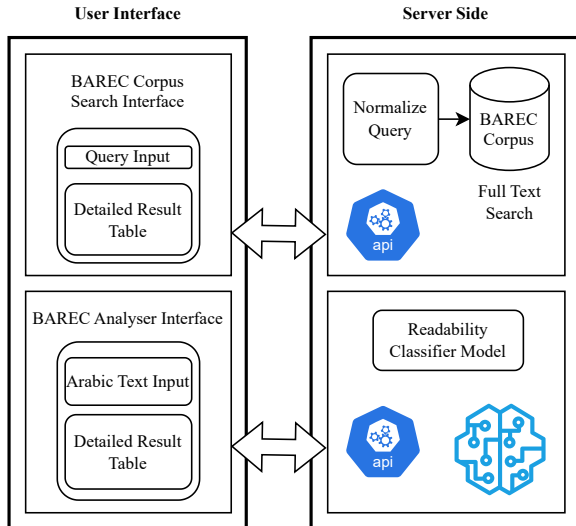


Figure 2: Overview of the BAREC System Architecture. This diagram illustrates the interaction between the user interface components (BAREC Corpus Search Interface and BAREC Analyze Interface) and the server-side services via APIs, including the BAREC Corpus for full-text search and the Readability Classifier Model.

training is performed on an NVIDIA V100 GPU for six epochs, with a learning rate of 5×10^{-5} , a batch size of 64, and a cross-entropy loss function for multi-class classification over 19 readability levels. We report of its performance in §6.

4 System Design and Implementation

At a high level, the BAREC demo follows a classic web-based client-server architecture, with additional linguistic processing and quality control components. Figure 2 provides a system design overview. The core components include: (1) a database and back-end services for managing the annotated corpus; (2) a linguistic processing module that analyzes sentences and fetches annotated dataset information; (3) a front-end web interface for users; and (4) BAREC Analyzer model, an automatic readability assessment system. We discuss these components in some detail next.

4.1 Design Considerations

The BAREC demo design prioritizes efficient search, data accessibility, and a user-friendly interface. Following are the key design choices we made to address the unique challenges of Arabic text processing, large dataset management, and responsive web delivery.

Efficient Arabic Full-Text Search A primary design goal was to enable highly effective and ac-

curate search across a large corpus of Arabic text. This necessitates specialized handling of Arabic script complexities, including diacritics, letter elongations (Kashidas), and character variations (e.g., different forms of Alif Hamza). In addition to these orthographic challenges, the system also addresses some of Arabic’s rich morphological structure. For example, a search for the word *تفسير* *tfstyr*⁶ ‘explanation’ should return morphologically related forms like *تفسيرها* *tfstyrhA* ‘its explanation’, *التفسير* *Altfsyr* ‘the explanation’, and *تفسيرات* *tfstyrAt* ‘explanations’. We apply orthographic normalization (removing Hamzas, collapsing Alif Maqsura and Yeh, etc.) on both the indexing and query sides. We also use partial matching to address Arabic’s rich concatenative morphology.⁷ Without such processing, Arabic’s orthographic ambiguity and morphological variability would severely limit search performance.

Modular and Maintainable Architecture The system is designed with a modular architecture that cleanly separates the back-end (API and data logic) from the front-end (user interface). Built using the Express.js framework, this structure improves maintainability, simplifies debugging, and enables independent development and scaling of each layer.

Responsive Web Interface The front-end is designed to be accessible via a web browser, providing an intuitive interface for users to interact with the search and analysis functionalities. The use of EJS (Embedded JavaScript) templating ensures dynamic content rendering and language internationalization (Arabic/English) support, catering to a diverse user base.

API-Driven Communication The interaction between the front-end and back-end is entirely driven by RESTful APIs. This design allows for a decoupled system, enabling future expansion to other client types (e.g., mobile applications) without requiring significant changes to the back-end.

4.2 Main Interfaces

The system provides two main Web user interfaces.

Search Interface This interface enables users to explore the BAREC pre-annotated. Users can query the corpus by specific criteria such as *book*,

⁶Arabic HSB Romanization (Habash et al., 2007).

⁷We leave matching on morphological roots or across templatic variants to future work.

المؤلف	الكتاب	الجملة	المستوى الانقراضي
#	الإصدار: 1060	الطيور الكبيرة الخبيزة، قامت بتصحيح مسارها، واتجهت إلى موطنها الشتوي، بطريقة يصعب تفسيرها.	ي-10
المصدر: مجلة ماجد صنف النص: نص تأسيسي المجال: الفنون والعلوم الإنسانية			
+	الإصدار: 1060	التفسير الميسر الكامل للقرآن الكريم (جزء عم)	ن-14
+	الإصدار: 1060	سنعرف ذلك إن شاء الله في العدد القادم، حيث نواصل تفسير القرآن الكريم.	ي-10
+	الإصدار: 1269	التفسير الميسر الكامل للقرآن الكريم	ل-12
+	الإصدار: 1269	ولتفسير هذه القائمة من الأغذية، كشفوا عن حقيقة مهمة.. هي أن المواد النشوية، خصوصاً البطاطس والقمح والأرز، يتعامل معها الجسم بسهولة، ويخزن خلاصتها في العضلات والكبد، في صور (جليكوجين)، وهو نوع من السكريات يعتبر من أهم مصادر الطاقة الضرورية في المنافسات القوية.	ن-14
+	الإصدار: 1901	اقرأ القرآن، والكتب السهلة البسيطة للتفسير والسيرة النبوية الشريفة.	ل-12
+	#	كان الصحابي عبد الله بن العباس رضي الله عنهما عالماً (أ) التفسير والحديث. (ب) الطب (ج) الفلك (د) الكيمياء	ل-12
+	#	من مظاهر حفظ القرآن الكريم: (أ) اعتناء النبي والمسلمين به (ب) حفظه تلاوةً وكتابةً (ج) تفسيره (د) جميع ما سبق	ل-12
+	الدراسات الإسلامية للصف الرابع	تفسيرية للمفردات الواردة في السورة.	م-13
+	الدراسات الإسلامية للصف الرابع	ثم أحضر كتاب التفسير، وقرأ ما كتبه المفسرون حول الآية الكريمة.	ل-12

Figure 3: BAREC Demo search interface. The main search UI allows querying by sentence, author, or book. Users can navigate annotated dataset entries and expand metadata by clicking the (+) icon. The query *تفسير تفسير* 'explanation' returns morphologically related forms. **The English version is in Appendix A Figure 5.**

author, or *sentence words* (Figure 3). The back-end performs a full-text search in the PostgreSQL database, processes the results, and sends a response back to the UI. The search results are dynamically displayed in a paginated table, showing the retrieved text segments along with their associated readability levels, as well as the book title, author, domain, and other metadata.

Analyze Interface This component allows users to input arbitrary Arabic text into a dedicated text area. Upon submission, the system processes the text in real time and provides an immediate readability assessment for each sentence. The results include a visual readability bar and a detailed tabular breakdown (Figure 4). The table presents three key elements: (a) an estimate of the overall readability level, defined as the highest predicted level among all sentences; (b) sentence-level labels across 19

fine-grained readability levels, reflecting individual sentence complexity; (c) and a visual summary of the distribution of readability levels within the text, helping users assess variation across the passage.

4.3 Implementation

The BAREC demo is a web application with a modular front-end/back-end architecture for efficient processing and retrieval of Arabic text.

Back-end Built with Express.js,⁸ the back-end provides RESTful APIs for accessing the annotated dataset and for analyzing user-submitted text using the BAREC readability model. All data is stored in a PostgreSQL⁹ database, which includes meta-data such as source, author, readability levels, and

⁸<https://expressjs.com>

⁹<https://www.postgresql.org>

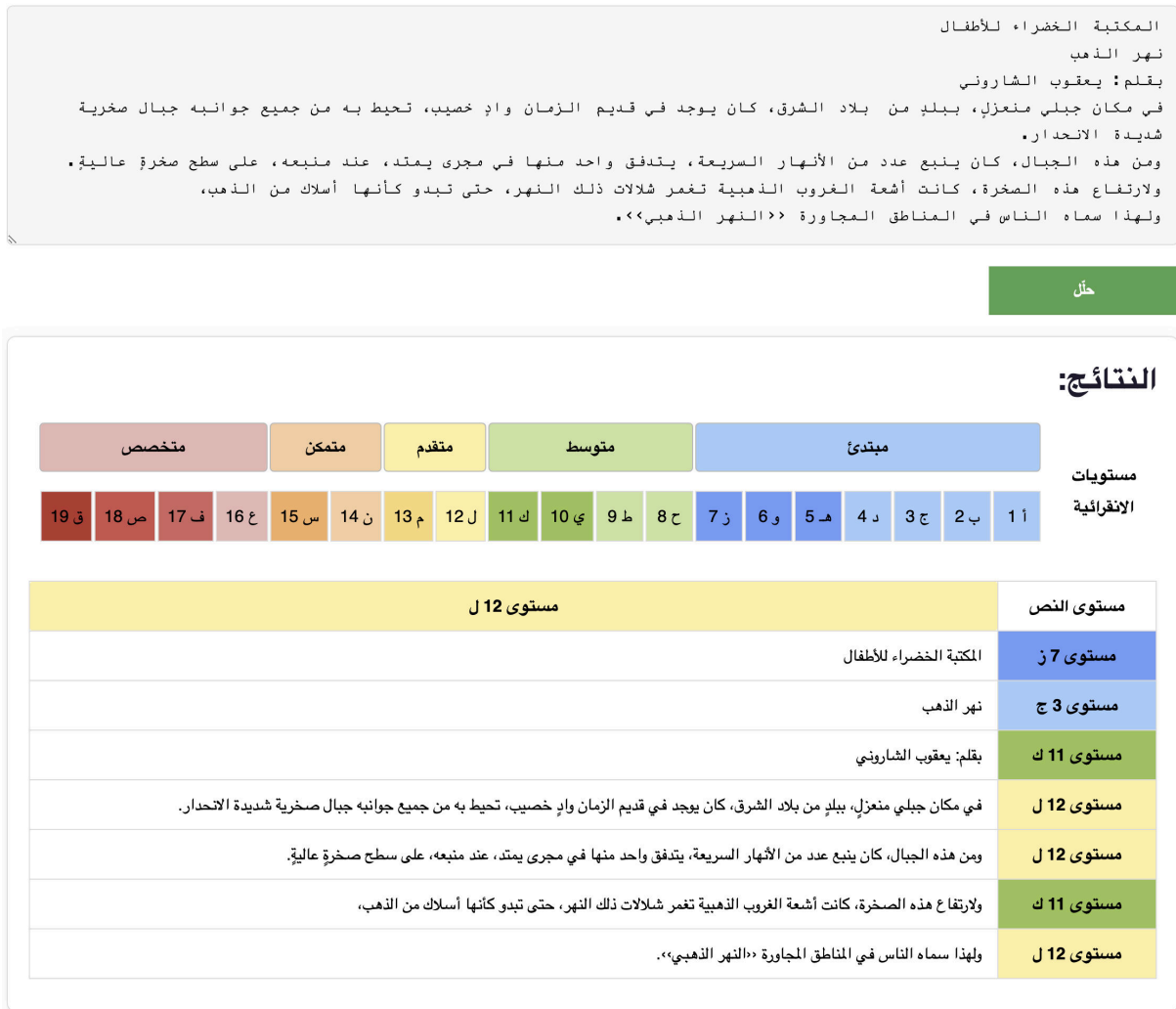


Figure 4: The BAREC Demo Analyze Interface, including the text input area, the Readability Bar (colored guide bar for readability level), the overall Text Readability Level, and the detailed, sentence-by-sentence readability levels. The English version of the interface is in Appendix B Figure 6.

domain. The AI model performs sentence-level analysis and returns results to the front-end.

Front-end The interface uses EJS templating for dynamic server-side rendering and interaction with the back-end services.

5 Use Case and Example Scenario

This section demonstrates the BAREC Demo's Search and Analyze utilities through typical user interactions and output interpretation.

5.1 Search Interface Walkthrough

The Search interface empowers users to explore the BAREC annotated corpus (Figures 3 and 5).

- **Query Input** Users navigate to the Search page, where a prominent search bar is available for keyword input.

- **Search Parameters** Users can explore the corpus by searching across various dimensions such as *Author, Book, or Sentence*. For instance, a user might search for all sentences by a particular author to analyze their writing style across different readability levels.
- **Dynamic Table Rendering** Search results are dynamically displayed in a responsive, paginated table, allowing users to browse through the retrieved segments efficiently.
- **Result Columns** The search results table presents key columns (from right to left): *Readability Level, Sentence, Book, and Author*. Additional metadata, such as *Source, Text Class, and Domain* are also available through an expansion by clicking on (+) at the

leftmost part of the record.

In Figure 3, the search term is *تفسير* *tfsyr* ‘explanation’. The first record with the expanded metadata view has the word *تفسيرها* *tfsyrhA* ‘its explanation’ in a sentence from a children’s magazine.

5.2 Analyze Interface Walkthrough

The Analyze interface provides real-time readability assessment of user-provided Arabic text (Figures 4 and 6).

Text Input Users navigate to the Analyze Interface, which presents a clear text area for input. They can enter any Arabic text, ranging from a single sentence to a longer passage.

Analysis Process Upon clicking the *Analyze* button, the system processes the input text using its fine-grained readability models. The back-end sends the text to the analysis server, which returns detailed readability levels.

Readability Bar The system then displays a *Readability Row* listing levels from level 1 *أ 1 Alif* to 19 *ق 19 Qaf*. This colored bar provides an immediate, intuitive graphical guide of the detected readability levels for the overall text or for individual sentences within the input. The colors and labels correspond directly to the 19 BAREC levels, offering a quick visual summary of the text’s complexity. For example, predominantly green labels might indicate an easier text, while a mix of yellow and red could signal varying levels of difficulty.

Detailed Result Table Below the readability bar, a detailed tabular output is shown. The header of this table indicates the Text Level (defined as the maximum of the text sentence levels). Next, the table provides a sentence-by-sentence breakdown of the analysis, listing each sentence from the input text alongside its predicted readability level with matching color for easy visualization. This allows users to quickly pinpoint specific sentences that contribute to the overall text complexity.

In Figure 4, the text is the opening to a children’s book called *نهر الذهب* ‘The Golden River’. The text snippet includes seven sentences/fragments, three of which are at level 12 *ل 12 Lam* (around fifth grade reading), two are at level 11 *ك 11 Kaf* (around fourth grade reading), and the rest (titles of series and book) are further below. The overall text level is 12 *ل 12 Lam*.

6 Evaluation

We evaluate the Analyzer using Elmadani et al.’s (2025) AraBERTv02+Word+CE setup, and report on the following metrics:

- **Acc:** Exact match accuracy for 19-, 7-, 5-, and 3-level groupings (Figure 1).
- **± 1 Acc¹⁹:** Accuracy within one level of the gold label (19-level).
- **Dist:** Average absolute error between prediction and gold.
- **Quadratic Weighted Kappa (QWK):** Weighted agreement score penalizing larger errors (Cohen, 1968; Doewes et al., 2023).

On the BAREC test set, the AraBERTv02+Word+CE model (Antoun et al., 2020) (see Section 3.2) achieves an exact accuracy of 55.8% on the 19-level scheme (Acc¹⁹). When collapsing the levels, the accuracy jumps to 64.9%, 69.1%, and 74.7% for the 7-, 5-, and 3-level schemes, respectively. The adjacent accuracy (± 1 Acc¹⁹) reaches 69.4%, indicating that most predictions are close to the correct level. The average **distance** between predictions and gold labels is 1.09 (out of 19), and the **QWK** score is **81.0%**, reflecting strong overall agreement.

7 Conclusions and Future Work

The BAREC demo fills a key gap in Arabic NLP by offering an intuitive interface for sentence-level readability assessment across 19 levels. It supports educators and content creators through two core tools: a search interface for exploring a large, manually annotated corpus, and an analyzer for real-time text evaluation.

Future work includes expanding the corpus to 10 million words across a wider range of genres and dialects, refining annotation guidelines based on ongoing insights and user feedback, enhancing model accuracy through advanced linguistic features and machine learning techniques, and conducting in-depth user studies to guide usability improvements and feature development.

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Limitations

Readability assessment, despite rigorous guidelines and extensive training of annotators, inherently involves a degree of subjectivity. This can lead to some variability in annotation decisions and, consequently, in model predictions. While the BAREC corpus is extensive and diverse, it may not fully capture the entire linguistic landscape of the Arab world, nor all possible genres, styles, or regional nuances. This limitation could affect the generalizability of the models, particularly for less represented text types. Furthermore, potential biases or gaps might exist in the corpus due to the selection of source materials or inherent limitations in the manual annotation process.

Ethics Statement

The BAREC project is committed to upholding high ethical standards. All data utilized in the corpus curation process has been sourced responsibly and legally, respecting intellectual property rights. The manual annotation process is conducted with transparency and fairness, involving multiple annotators to mitigate individual biases and ensure reliability. All annotators are compensated fairly for their contributions. It is explicitly recognized that readability measures, like any AI assessment system, could potentially be misused, for instance, for biased profiling of individuals based on their writing style. However, this is not the intended purpose of BAREC, and such malicious use is strongly discouraged. BAREC is designed to function as a supportive tool for educators, learners, and content creators, rather than as a definitive or judgmental evaluator. The commitment to making the BAREC corpus and its associated guidelines openly accessible promotes transparency, reproducibility of research, and fosters collaborative advancements within the Arabic language research community.

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A BAREC Demo Search Interface (English Version)

SEARCH

Found 130 results for "تفسير".

	AUTHOR	BOOK	SENTENCE	READABILITY LEVEL
-	#	Edition: 1060	الطيور الكبيرة الخبيثة، قامت بتصحيح مسارها، واتجهت إلى موطنها الشتوي، بطريقة يصعب تفسيرها.	10-ya
Source: Majed Text Class: Foundational Domain: Arts & Humanities				
+	#	Edition: 1060	التفسير المبسّر الكامل للقرآن الكريم (جزء عم)	14-nun
+	#	Edition: 1060	سنعرف ذلك إن شاء الله في العدد القادم، حيث نواصل تفسير القرآن الكريم.	10-ya
+	#	Edition: 1269	التفسير المبسّر الكامل للقرآن الكريم	12-lam
+	#	Edition: 1269	ولتفسير هذه القائمة من الأغذية، كشفوا عن حقيقة مهمة.. هي أن المواد التشوية، خصوصاً البطاطس والقمح والأرز، يتعامل معها الجسم بسهولة، ويخزن خلاصتها في العضلات والكبد، في صور (جليكوجين)، وهو نوع من السكريات يعتبر من أهم مصادر الطاقة الضرورية في المنافسات القوية.	14-nun
+	#	Edition: 1901	اقرأ القرآن، والكتب السهلة البسيطة للتفسير والسيرة النبوية الشريفة	12-lam
+	#	#	كان الصحابي عبد الله بن العباس رضي الله عنهما عالماً (أ) التفسير والحديث. (ب) الطب (ج) الفلك (د) الكيمياء	12-lam
+	#	#	من مظاهر حفظ القرآن الكريم: (أ) اعتناء النبي والمسلمين به (ب) حفظه تلاوةً وكتابةً (ج) تفسيره (د) جميع ما سبق	12-lam
+	#	Grade 4 Islamic Studies	تفسيرِي لِلْمُفْرَدَاتِ الْوَارِدَةِ فِي السُّورَةِ.	13-mim
+	#	Grade 4 Islamic Studies	لَمْ أُحْضِرْ كِتَابَ التَّفْسِيرِ، وَقَرَأْتُ مَا كَتَبَهُ الْمُفَسِّرُونَ حَوْلَ آيَةِ الْكَرِيمَةِ.	12-lam

Figure 5: BAREC Demo search interface. The main search UI allows querying by sentence, author, or book. Users can navigate annotated dataset entries and expand metadata by clicking the (+) icon. The query *تفسير* *tfysr* ‘explanation’ returns morphologically related forms.

B BAREC Demo Analyze Interface (English Version)

المكتبة الخضراء للأطفال
نهر الذهب
بقلم: يعقوب الشاروني
في مكان جبلي منعزل، ببلد من بلاد الشرق، كان يوجد في قديم الزمان وادٍ خصيب، تحيط به من جميع جوانبه جبال صخرية شديدة الانحدار.
ومن هذه الجبال، كان ينبع عدد من الأنهار السريعة، يتدفق واحد منها في مجرى يمتد، عند منبعه، على سطح صخرة عالية.
ولارتفاع هذه الصخرة، كانت أشعة الغروب الذهبية تغمر شلالات ذلك النهر، حتى تبدو كأنها أسلاك من الذهب، ولهذا سماه الناس في المناطق المجاورة «النهر الذهبي».

ANALYZE

Results:

Readability	Expert	Proficient	Advanced	Intermediate	Beginner														
Levels	19 ق	18 ص	17 ف	16 ع	15 س	14 ن	13 م	12 ل	11 ك	10 ي	9 ط	8 ح	7 ز	6 و	5 هـ	4 د	3 ج	2 ب	1 أ

Text Level	Level 12 Lam
المكتبة الخضراء للأطفال	Level 7 Zay
نهر الذهب	Level 3 Jim
بقلم: يعقوب الشاروني	Level 11 Kaf
في مكان جبلي منعزل، ببلد من بلاد الشرق، كان يوجد في قديم الزمان وادٍ خصيب، تحيط به من جميع جوانبه جبال صخرية شديدة الانحدار.	Level 12 Lam
ومن هذه الجبال، كان ينبع عدد من الأنهار السريعة، يتدفق واحد منها في مجرى يمتد، عند منبعه، على سطح صخرة عالية.	Level 12 Lam
ولارتفاع هذه الصخرة، كانت أشعة الغروب الذهبية تغمر شلالات ذلك النهر، حتى تبدو كأنها أسلاك من الذهب،	Level 11 Kaf
ولهذا سماه الناس في المناطق المجاورة «النهر الذهبي».	Level 12 Lam

Figure 6: The BAREC Demo Analyze Interface, including the text input area, the Readability Bar (colored guide bar for readability level), the overall Text Readability Level, and the detailed, sentence-by-sentence readability levels.