



# Qur'anic Passage Retrieval for QA Systems

Mohamed Basem 220017 Islam Abdulhakeem 224179

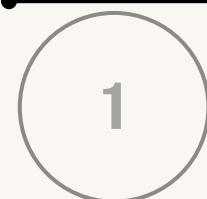
Supervised By:



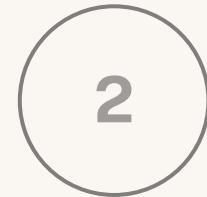
Dr. Ali Hamdi & Prof. Ammar

# Agenda

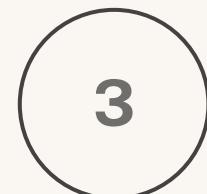
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Introduction



Motivation



Bibliography Grid



Related Work 1



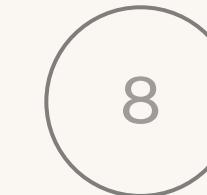
Related Work 2



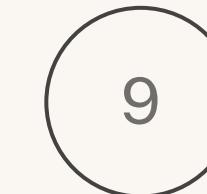
Research Limitations



Research Problem Statement



Research Objectives



Model Architecture



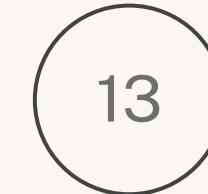
System Architecture



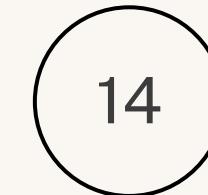
Datasets



Methodology



Results



Demo



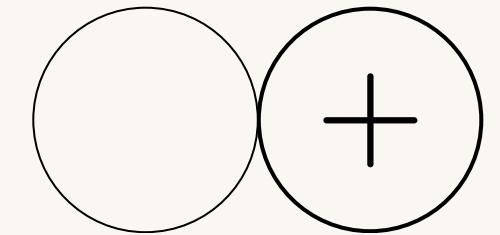
Conclusion



References

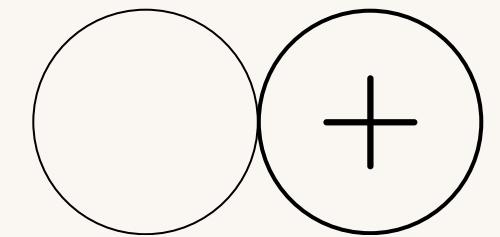
# Introduction

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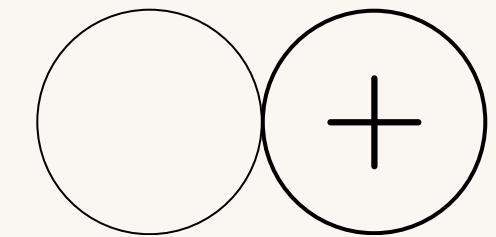
- Global Muslim Population: With an estimated 2 billion Muslims worldwide [1].
- Accessibility Challenge: The Quran's guidance is limited by linguistic barriers for non-Arabic speakers and even native speakers unfamiliar with Classical Arabic (CA).
- Linguistic Gap: A significant gap exists between Modern Standard Arabic (MSA), commonly used in questions, and the Quran's Classical Arabic (CA).

# Qur'an QA shared-task



The image shows the homepage of the Qur'an QA 2023 Shared Task website. The header features a yellow bar with links for 'Award winners are announced!' and 'Congratulations!'. Below the header is a large banner with a dark background and intricate gold Arabic calligraphy. The main title 'Qur'an QA 2023 Shared Task!' is displayed in white, with the subtitle 'Answering Questions on the Holy Qur'an' in yellow. A subtitle at the bottom of the banner reads '@ ArabicNLP 2023, co-located with EMNLP 2023' and 'Singapore, December 2023'. To the left of the banner is a sidebar with a blue icon and the text 'Qur'an QA 2023 Shared Task!'. Below this are links for Home, Task A, Task B, Important Dates, Awards, Paper Submission, Accepted Papers, Award Winners, and FAQ. At the bottom of the page, there is a brown footer bar with the text 'Welcome to Qur'an QA 2023 Shared Task!', 'Check last year's version: Qur'an QA 2022 Shared Task!', and a search icon.

# Qur'an QA shared-task



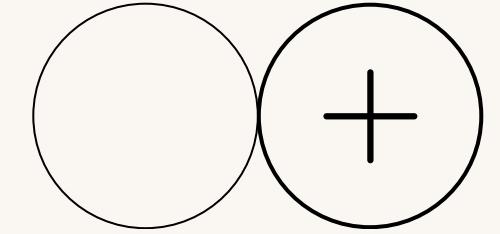
- Task A: Passage Retrieval: Given a free-text question in Modern Standard Arabic (MSA) and a Quranic passage collection.

**السؤال / Question:** من هم الملائكة المذكورون في القرآن؟

# Golden Qur'anic Passages الفقرات القرآنية الذهبية

- (2:87-88) وَلَقَدْ أَتَيْنَا مُوسَى الْكِتَبَ وَفَقَيْنَا مِنْ بَعْدِهِ بِالرُّسُلِ وَأَتَيْنَا عِيسَى ابْنَ مَرْيَمَ الْبَيْتَ وَأَيَّدْنَاهُ بِرُوحِ الْفُدْسِ أَفَكُلَّمَا جَاءَكُمْ رَسُولٌ بِمَا لَا تَهْوَى أَنفُسُكُمْ أَسْتَكْبِرُتُمْ فَقَرِيقًا كَذَبْتُمْ وَقَرِيقًا نَفْتَلُونَ. وَقَالُوا قُلُوبُنَا غُلْفٌ بَلْ لَعْنَهُمُ اللَّهُ بِكُفْرِهِمْ فَقَلِيلًا مَا يُؤْمِنُونَ.
  - (2:97-101) قُلْ مَنْ كَانَ عَدُوا لِجَبْرِيلَ فَإِنَّهُ نَزَّلَهُ عَلَى قَبْلِكَ بِإِذْنِ اللَّهِ مُصَدِّقًا لِمَا بَيْنَ يَدِيهِ وَهُدًى وَبُشْرَى لِلْمُؤْمِنِينَ. مَنْ كَانَ عَدُوا لِلَّهِ وَمَلَائِكَتِهِ وَرُسُلِهِ وَجَبْرِيلَ وَمِيكَلَ فَإِنَّ اللَّهَ عَدُوُّ لِلْكُفَّارِينَ. وَلَقَدْ أَنْزَلْنَا إِلَيْكَ آيَاتٍ بَيْنَتِ مَا يَكْفُرُ بِهَا إِلَّا الْفَسُوقُونَ. أَوْكُلَّمَا عَهْدُوا عَهْدًا نَبَذُهُ فَرِيقٌ مِنْهُمْ بَلْ أَكْثَرُهُمْ لَا يُؤْمِنُونَ. وَلَمَّا جَاءَهُمْ رَسُولٌ مِنْ عِنْدِ اللَّهِ مُصَدِّقٌ لِمَا مَعَهُمْ نَبَذَ فَرِيقٌ مِنَ الَّذِينَ أَوْتُوا الْكِتَبَ كِتَبَ اللَّهِ وَرَأَءَ ظُهُورَهُمْ كَانُوكُمْ لَا يَعْلَمُونَ.
  - (2:102-103) وَاتَّبَعُوا مَا شَنَلُوا الشَّيَاطِينُ عَلَى مُلْكِ سُلَيْمَنَ وَلَكِنَّ الشَّيَاطِينَ كَفَرُوا يُعْلَمُونَ النَّاسُ السِّحْرَ وَمَا أُنْزَلَ عَلَى الْمَلَكِينَ بِبَابِلِ هَرُوتَ وَمِرْوَتَ وَمَا يُعْلَمُانِ مِنْ أَحَدٍ حَتَّى يَقُولَا إِنَّمَا نَحْنُ فِتْنَةٌ فَلَا تَكْفُرْ فَيَتَعَلَّمُونَ مِنْهُمَا مَا يُفَرِّقُونَ بِهِ بَيْنَ الْمَرْءَ وَرَوْجَهِ وَمَا هُمْ بِضَارَّينَ بِهِ مِنْ أَحَدٍ إِلَّا بِإِذْنِ اللَّهِ وَيَتَعَلَّمُونَ مَا يَضُرُّهُمْ وَلَا يَنْفَعُهُمْ وَلَقَدْ عِلِّمُوا لَمَنِ أَشْتَرَاهُ مَالَهُ فِي الْأَخْرَةِ مِنْ خَلْقٍ وَلَيْسَ مَا شَرَوْا بِهِ أَنفُسَهُمْ لَوْ كَانُوا يَعْلَمُونَ. وَلَوْ أَنَّهُمْ ءامَنُوا وَاتَّقُوا لِمَنْ تَوَبَّ مِنْ عِنْدِ اللَّهِ خَيْرٌ لَوْ كَانُوا يَعْلَمُونَ.

# Qur'an QA shared-task



- Task B: Extractive QA: Given a Quranic passage and a question in MSA, then the system extract all answers .

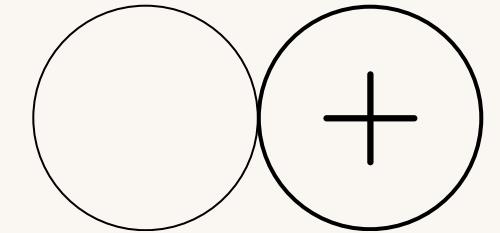
الفقرة القرآنية (74:32-48)  
Qur'anic Passage (74:32-48)  
كَلَّا وَالْفَمْرُ. وَاللَّيْلُ إِذَا أَدْبَرَ. وَالصَّبْحُ إِذَا أَسْفَرَ. إِنَّهَا لِإِحْدَى الْكُبَرِ. تَذِيرًا لِلْبَشَرِ.  
لَمْنَ شَاءَ مِنْكُمْ أَنْ يَتَقدَّمَ أَوْ يَتَأَخَّرَ. كُلُّ نَفْسٍ بِمَا كَسَبَتْ رَهِينَةً. إِلَّا أَصْنَحَ  
الْيَمِينَ. فِي جَنَّتٍ يَشَاءُلُونَ.  
عَنِ الْمُجْرِمِينَ.  
مَا سَلَكُمْ فِي سَقَرَ.  
قَالُوا لَمْ نَكُ مِنَ الْمُصَلَّيْنَ.  
وَلَمْ نَكُ نُطْعَمُ الْمِسْكِيْنَ.  
وَكُلُّا نَحُوْضُ مَعَ الْخَائِضِيْنَ.  
وَكُلُّا نُكَدِّبُ  
بِيَوْمِ الدِّيْنِ.  
حَتَّىٰ أَتَنَا الْيَقِيْنَ.  
فَمَا تَنْفَعُهُمْ شَفَعَةُ الشَّفَعِيْنَ.

السؤال / Question : ما هي الدليل التي تشير بأن الانسان مخير؟

الإجابات الذهبية / Gold Answers :

- لَمْنَ شَاءَ مِنْكُمْ أَنْ يَتَقدَّمَ أَوْ يَتَأَخَّرَ
- كُلُّ نَفْسٍ بِمَا كَسَبَتْ رَهِينَةً

# Motivation



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## 1. Growing Demand for Digital Islamic Resources

Increasing interest in digital platforms that provide easy access to religious knowledge.

## 2. Educational and Community Impact

A tool like this can support students, educators, and communities in their study and teaching of the Quran.

## 3. Addresses Linguistic Challenges

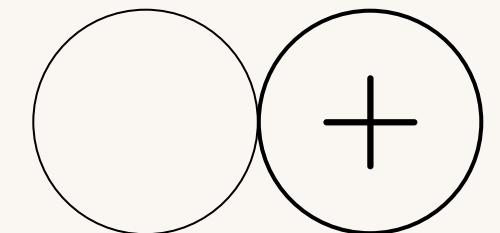
Bridges the gap between Modern Standard Arabic (MSA) and Classical Arabic for more precise responses.

# Bibliography Grid

citation	Problem	Contribution	Result
<p>Mohammed Elkomy and Amany Sarhan. 2023. <i>TCE at Qur'an QA 2023 Shared Task: Low Resource Enhanced Transformer-based Ensemble Approach for Qur'anic QA</i></p>	<ul style="list-style-type: none"><li><i>language differences between MSA and Classical Arabic</i></li></ul>	<ul style="list-style-type: none"><li>Ensemble of Arabic transformer models</li><li>Fine-tune the models with transfer learning.</li><li>use external Arabic datasets</li></ul>	<ul style="list-style-type: none"><li>Task A:(MAP 0.25)</li></ul>
<p>Hessa Alawwad, Lujain Alawwad, Jamilah Alharbi, and Abdullah Alharbi. 2023. <u>AHJL at Qur'an QA 2023 Shared Task: Enhancing Passage Retrieval using Sentence Transformer and Translation.</u></p>	<ul style="list-style-type: none"><li>Qur'anic passages due to language complexity,</li><li>identifying 0 answer cases</li></ul>	<ul style="list-style-type: none"><li>Fine-tune 2 models for retrieving Qur'anic passages.</li><li>rephrase the questions.</li></ul>	<ul style="list-style-type: none"><li>Task A: (MAP 0.211 )</li></ul>
<p>Ghazaleh Mahmoudi, Yeganeh Morshedzadeh, and Sauleh Eetemadi. 2023. GYM at Qur'an QA 2023 Shared Task: Multi-Task Transfer Learning for Quranic Passage Retrieval and Question Answering with Large Language Models.</p>	<ul style="list-style-type: none"><li><i>language differences between MSA and Classical Arabic</i></li></ul>	<ul style="list-style-type: none"><li>A multi-task transfer learning system using TSDAE, SimCSE,</li><li>AraElectra for fine-tuning and reading comprehension</li></ul>	<ul style="list-style-type: none"><li>Task A: (MAP 0.122 )</li></ul>
<p>Sarah Alnefaie and Abdullah N. 2023. <i>LKAU23 at Qur'an QA 2023: Using Transformer Models for Retrieving Passages and Finding Answers to Questions from the Qur'an</i></p>	<ul style="list-style-type: none"><li>Retrieve relevant Qur'anic passages to answer Arabic questions.</li></ul>	<ul style="list-style-type: none"><li>Fine-tuned Arabic transformer models .</li><li>ensemble the models.</li></ul>	Task A: (MAP 0.124)

# Related Work 1

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TCE at Qur'an QA 2023 Shared Task: Low Resource Enhanced  
Transformer-based Ensemble Approach for Qur'anic QA:

# TCE at Qur'an QA 2023 Shared Task: Low Resource Enhanced Transformer-based Ensemble Approach for Qur'anic QA:

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## ***Problem***

- *Low Resources*
- *Zero-Answer Sensitivity*
- *Imbalanced Dataset Distribution*

## ***Contribution***

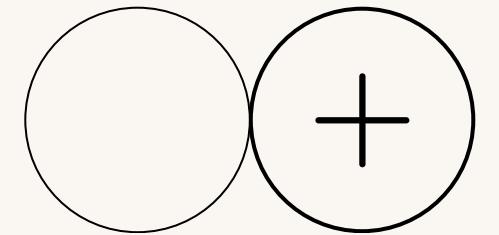
- *The approach involved an ensemble of Arabic transformer-based models enhanced by pipelined fine-tuning and transfer learning, which improved overall performance.*

## ***Result***

- *Task A : (MAP 0.25)*

# Related Work 2

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AHJL at Qur'an QA 2023 Shared Task: Enhancing Passage Retrieval using Sentence Transformer and Translation.

# LKAU23 at Qur'an QA 2023: Using Transformer Models for Retrieving Passages and Finding Answers to Questions from the Qur'an

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## **Problem**

- *Scarcity of High-Quality Training Data.*
- *Zero-Answer Sensitivity*
- *Imbalanced Dataset Distribution*

## **Contribution**

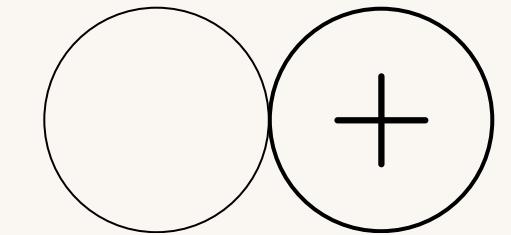
- *Fine-tune 2 models for retrieving Qur'anic passages.*
- *rephrase the questions.*

## **Result**

Task A: (MAP 0.211 )

# Research Limitations

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## **Model Effectiveness**

Many traditional approaches show inadequate performance with intricate Arabic structures.

## **Need for Specialized Datasets**

Fine-tuning on domain-specific datasets, like Quranic texts, is essential for relevance and accuracy.

## **Linguistic Diversity**

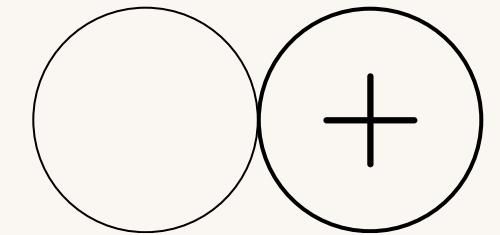
Variations in dialects and linguistic features pose challenges for universal model applicability.

## **Technological Gaps**

Many advanced NLP techniques remain underutilized or unadapted for the Arabic language.

# Problem Statement

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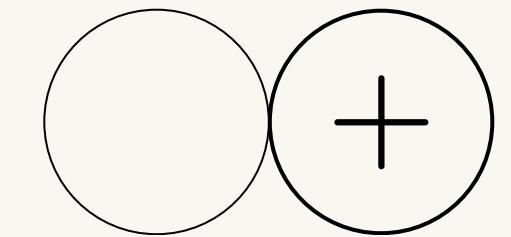


*The Quran's Classical Arabic poses comprehension challenges for non-Arabic speakers and native Arabic speakers unfamiliar with its style.*

*Bridging the gap between Modern Standard Arabic and Classical Arabic.*

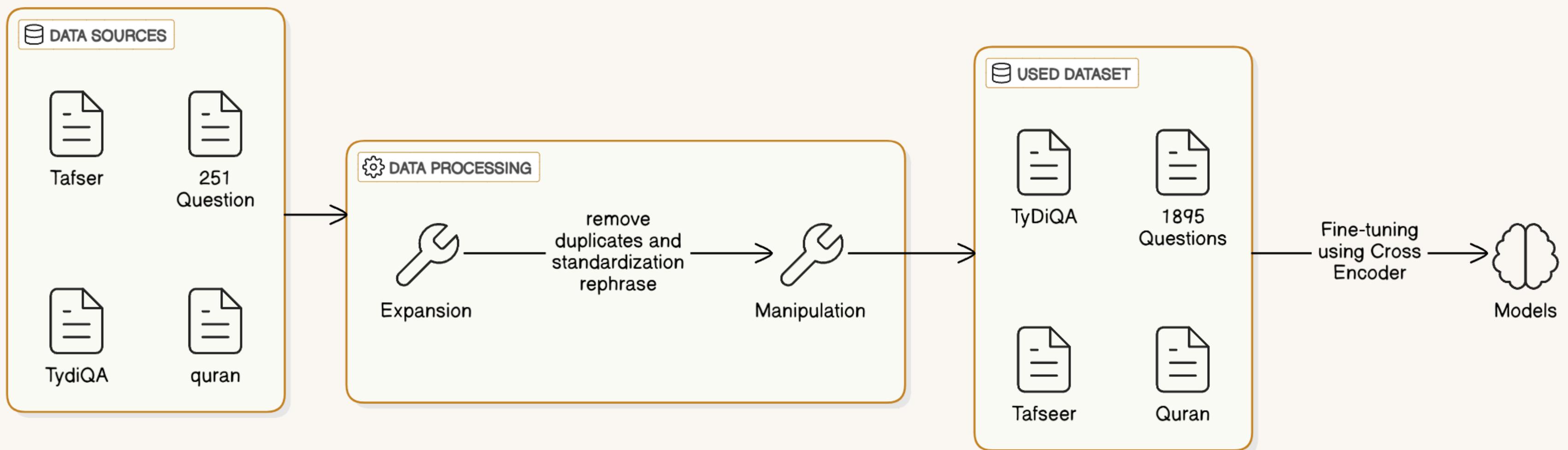
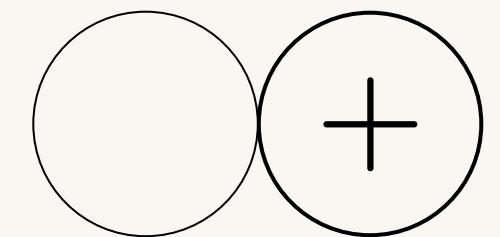
# Objectives

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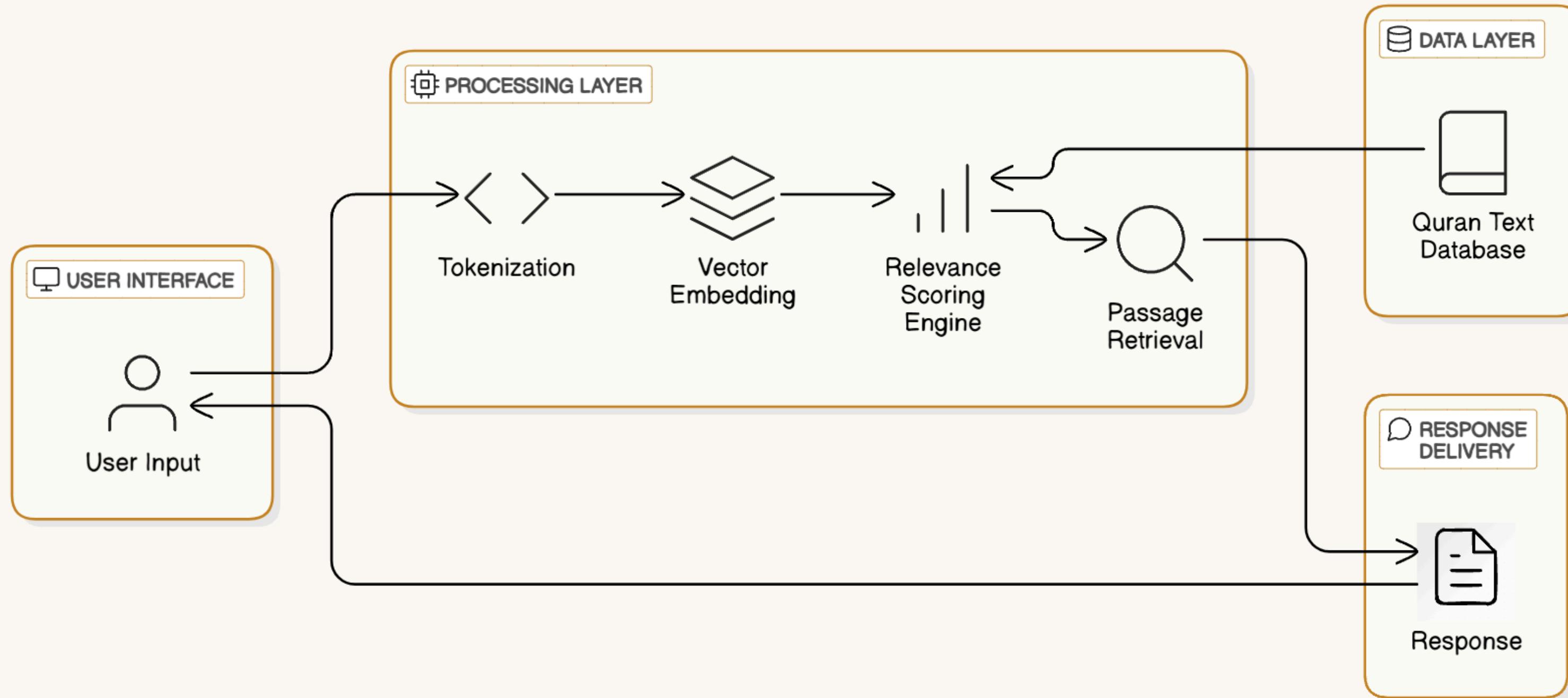
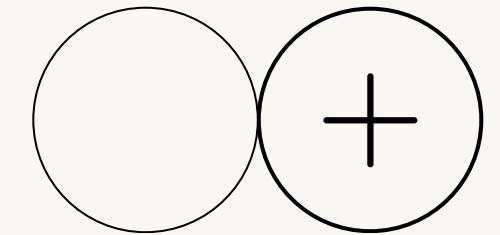


- **Expand the Quranic QA Dataset:** Increase the number and diversity of questions by rephrasing and categorizing existing ones .
- **Fine-Tune Language Models:** Adapt transformer models to effectively handle the linguistic nuances between MSA and Classical Arabic.
- **Improve Passage Retrieval Accuracy:** Achieve higher precision and recall in identifying relevant Quranic passages, specifically addressing single-answer, multi-answer, and zero-answer questions.
- **Provide Insights for Developing Robust QA Systems for Religious Texts:** Use the findings to contribute to broader NLP research in Arabic and religious text QA, helping bridge language and context gaps.

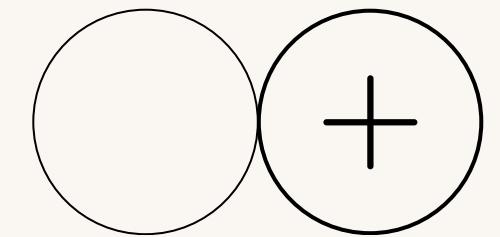
# Model Architecture



# System Architecture

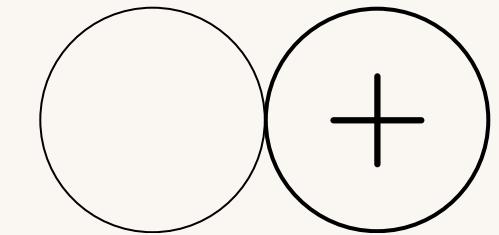


# DataSets



- ***Quran QA 2023 shared Dataset.***
- ***Quran-TafseerBook: Tafseer Al-Jalalayn .***
- ***PDF Files:***
  - Tafseer Book PDF: 1000 Q&A pairs based on Tafseer.***
  - List of Plants Citation: Contextual references to plants mentioned in the Quran and Hadith.***

# DataSets



## *Quran QA 2023 shared Dataset.*

Task A :

- Qur'anic Passage Collection (QPC): A collection of 1,266 passages created by topically segmenting the 114 Qur'anic chapters using the Thematic Holy Qur'an.
- AyaTEC Questions: Includes 251 questions .

Task B :

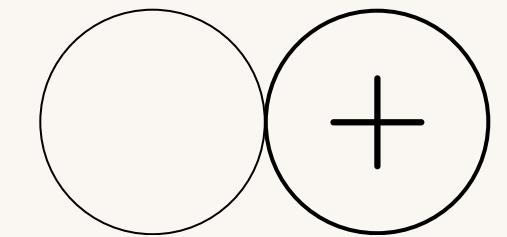
- Total Pairs: 1,562 question-passage pairs, including 469 new pairs.
- Answer Triplets: These pairs yield 1,889 question-passage-answer triplets.
- Zero-Answer Questions: 76 zero-answer questions (5% of dataset).

وذكر عيناً أياً بـ إذ نادى ربه أنِي مسني الشيطان بنصب وعذاب. ارکض برجلك هذا مقتول باردة":  
وشراب. ووهبنا له أهله ومثهم معهم رحمة منا وذكرى لأولي الألباب. وخذ بيديك ضغثاً فاضرب به ولا تحنث إنا وجدناه  
،".صابراً نعم العبد إله أواب

```
"pq_id": "38:41-44_105",
"passage": "واذكر عيناً أياً بـ إذ نادى ربه أنِي مسني الشيطان بنصب وعذاب. ارکض برجلك هذا مقتول باردة": وشراب. ووهبنا له أهله ومثهم معهم رحمة منا وذكرى لأولي الألباب. وخذ بيديك ضغثاً فاضرب به ولا تحنث إنا وجدناه ،".صابراً نعم العبد إله أواب",
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"verses": "41-44",
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# DataSets

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## ***Quran-TafseerBook: Tafseer Al-Jalalayn***

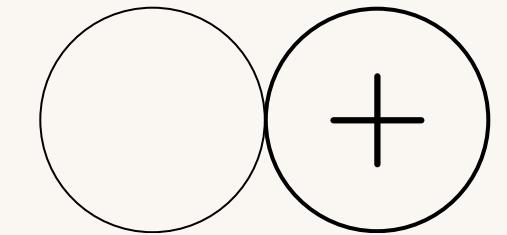
**Size:** 219,000 rows of insightful content

**Language:** Arabic

**Content:** This dataset features Quranic interpretations (tafsir) from the renowned classical work Tafseer Al-Jalalayn, authored by Jalal ad-Din al-Mahalli and Jalal ad-Din as-Suyuti. Known for its clarity and brevity, Tafseer Al-Jalalayn offers straightforward explanations of Quranic verses, making it an excellent resource for both beginners and advanced scholars.

**Purpose:** *To provide accessible explanations of Quranic text and contribute to extending the Quran QA dataset for enhancing Qur'anic question-answering systems.*

# DataSets



## **Tafseer Book PDF: 1000 Q&A pairs based on Tafseer**

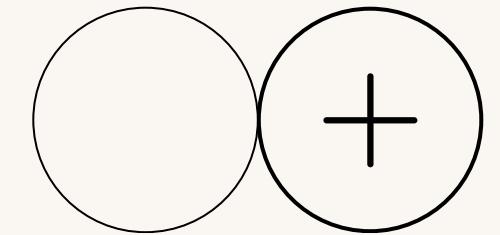
- **Content:** A collection of 1,000 questions and answers based on Qur'anic teachings, with insights from Tafseer and Islamic sciences.

## **List of Plants Citation: Contextual references to plants mentioned in the Quran and Hadith.**

- **Content:** provides an extensive list of plant names mentioned in both the Quran and the Sunnah. It offers valuable insights into the role of these plants in Islamic texts, their cultural significance, and their use in traditional medicine and practices.

**Purpose:** To provide easy-to-understand answers and to extend the Quran QA dataset for enhancing Qur'anic question-answering systems.

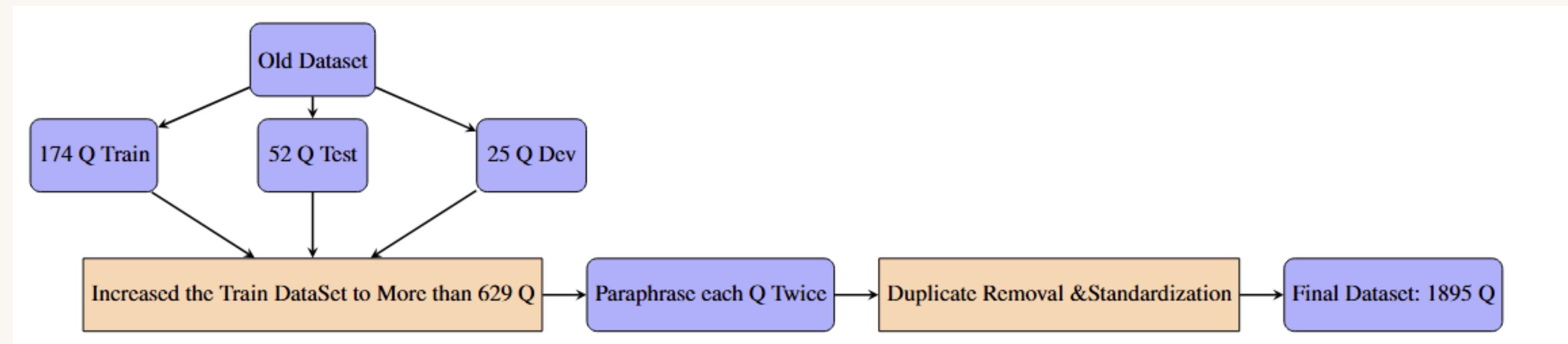
# Methodology



**Dataset Expansion:** The old dataset (251 questions) was expanded to 1,895 questions through rephrasing and additional data.

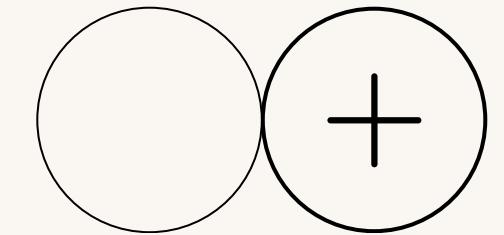
**Dataset Cleaning:**

- Duplicate Removal: Elimination of redundant questions and passages.
- Formatting Standardization: Ensuring queries were in Modern Standard Arabic.



# Methodology

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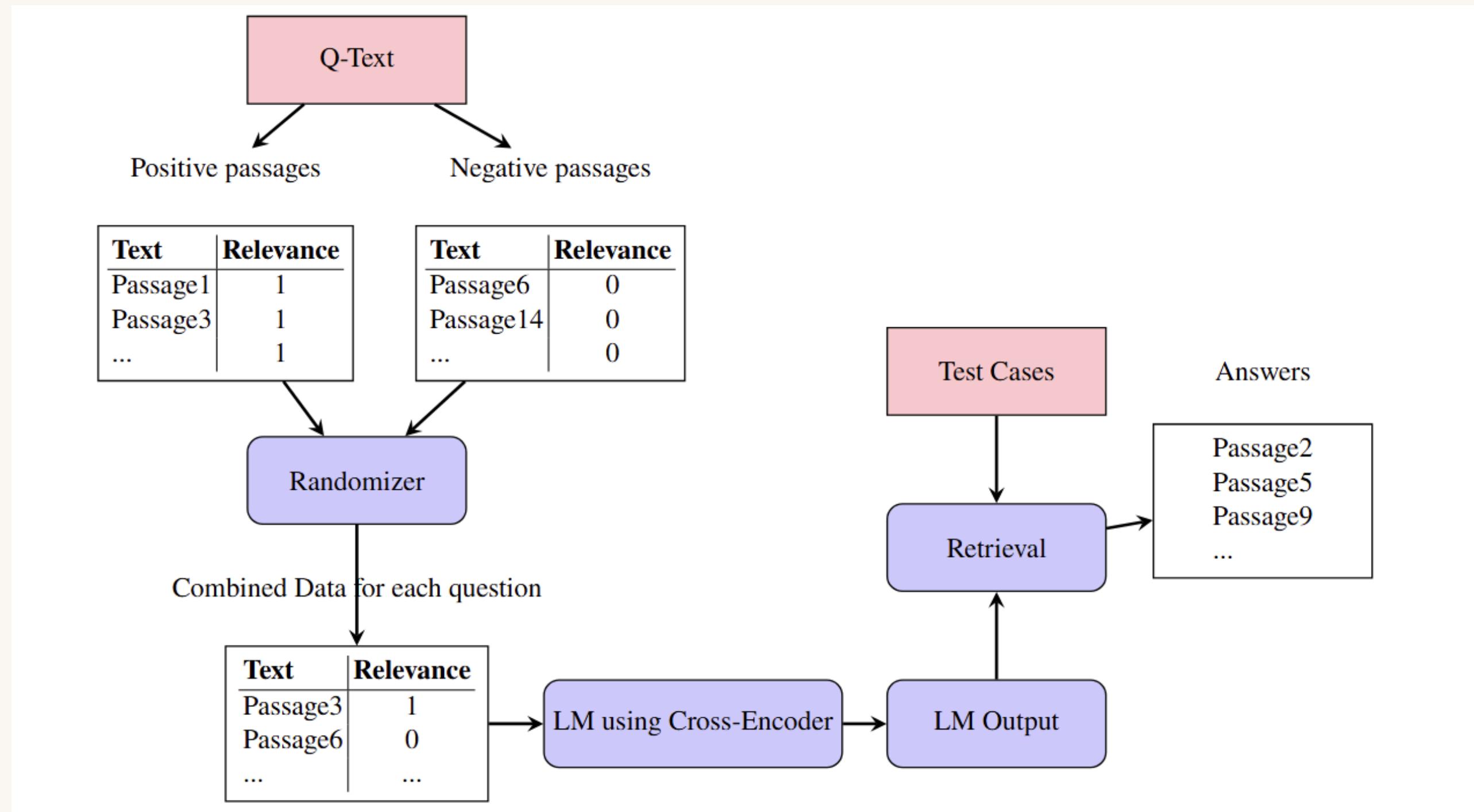
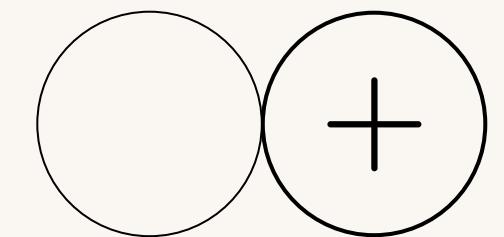
**Randomization:** A randomizer combines both positive and negative passages to create a dataset for each question.

**Cross-Encoder:** The cross-encoder analyzes the relationship between the question and passages to refine relevance predictions.

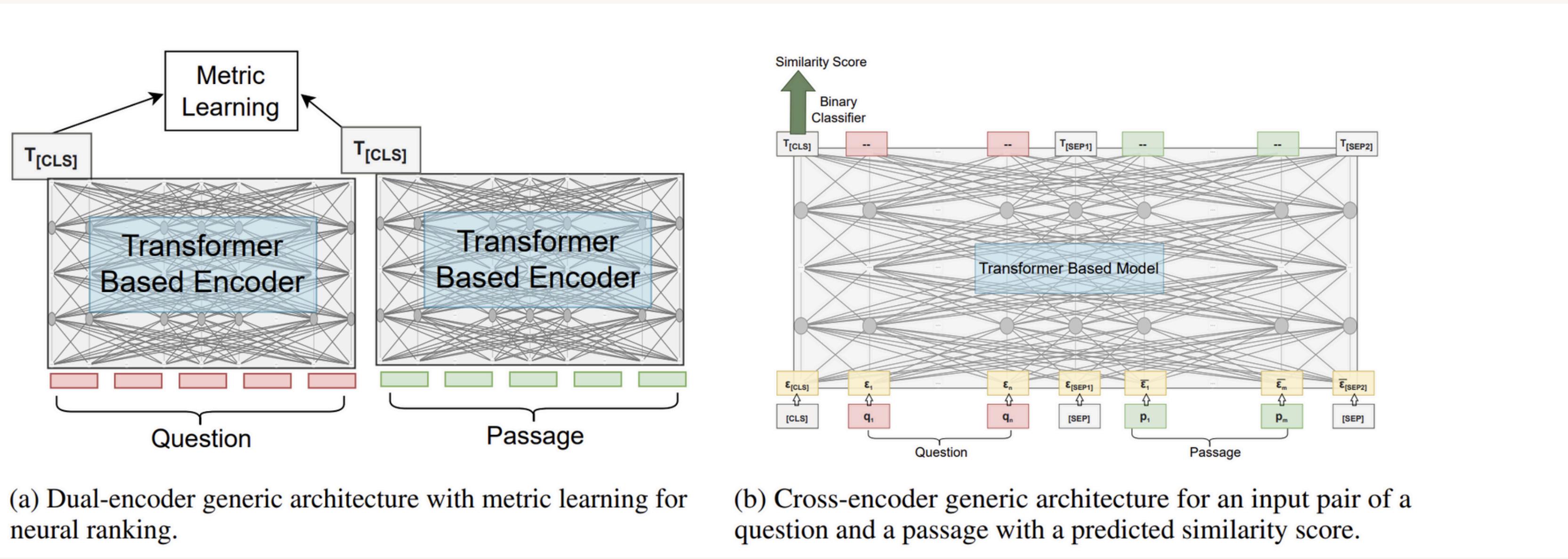
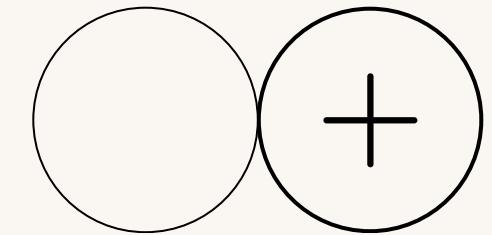
**Models Fine-Tuning:** Fine-tune Pre-trained models on the expanded dataset such as : BERT, RoBERTa-base, AraELECTRA, CAMeLBERT, AraBERT-base/large.

**Retrieval:** Calculate the relevance score for each passage.

# Methodology

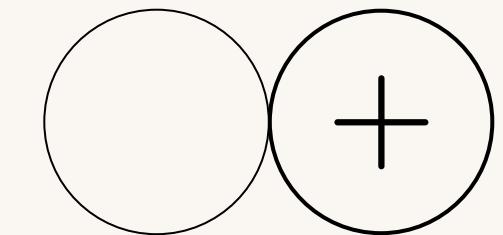


# Methodology



# Evaluation Metrics

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**Mean Average Precision (MAP):** Measures the precision of each rank position and compares it to the average in all queries

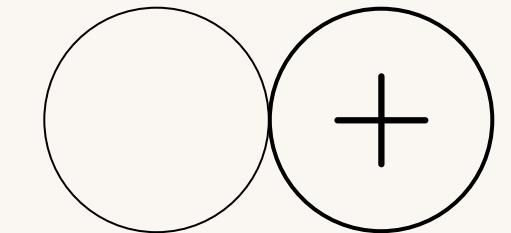
**Mean Reciprocal Rank (MRR):** Assesses the position of the first useful responses in the result list.

**Recall:** used to evaluate the effectiveness of the model in capturing relevant information in the highest rankings

**Precision:** Shows the actual percentage of relevant retrieved passages..

# Results

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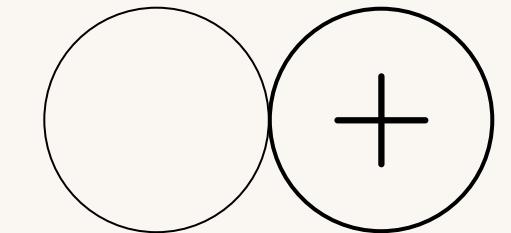


Comparison of multiple model versions based on MAP@10 and MRR evaluation metrics

Model	MAP@10		MRR	
	Baseline	Ours	Baseline	Ours
AraBERT-base	0.22	<b>0.36</b>	0.37	<b>0.59</b>
Roberta	0.05	<b>0.12</b>	0.01	<b>0.17</b>
AraBERT-large	0.28	<b>0.28</b>	0.40	<b>0.42</b>
Camelbert-Base	0.32	<b>0.34</b>	0.45	<b>0.47</b>
Araelectra-Base	0.21	<b>0.33</b>	0.29	<b>0.45</b>
bert-squad-accelerate	0.07	<b>0.25</b>	0.12	<b>0.40</b>

# Results

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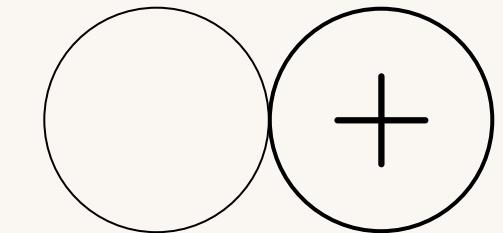


Comparison of multiple model versions based on Recall evaluation metrics.

Overall Recall	R@5		R@10		R@15		R@100		No Answer	
	Base	Ours	Base	Ours	Base	Ours	Base	Ours	Base	Ours
AraBERT-base	0.25	<b>0.37</b>	0.30	<b>0.50</b>	0.30	<b>0.50</b>	0.30	<b>0.50</b>	0.00	<b>0.25</b>
Roberta	0.10	<b>0.18</b>	0.14	<b>0.30</b>	0.14	<b>0.30</b>	0.14	<b>0.30</b>	0.00	<b>0.25</b>
AraBERT-large	0.31	<b>0.34</b>	0.38	<b>0.40</b>	0.38	<b>0.40</b>	0.38	<b>0.40</b>	0.00	<b>0.25</b>
Camelbert-Base	0.32	<b>0.36</b>	0.46	0.40	0.46	0.40	0.46	0.40	0.25	<b>0.50</b>
Araelectra-Base	0.31	<b>0.49</b>	0.42	<b>0.57</b>	0.42	<b>0.57</b>	0.42	<b>0.57</b>	0.25	<b>0.50</b>
bert-squad-accelerate	0.07	<b>0.32</b>	0.09	<b>0.35</b>	0.09	<b>0.35</b>	0.09	<b>0.35</b>	0.25	<b>0.75</b>

# Results

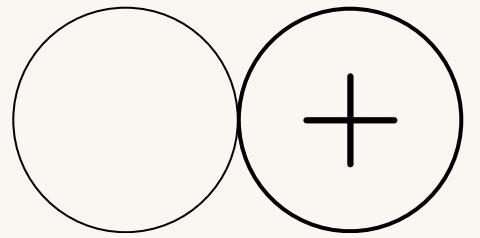
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Comparison of multiple model versions based on Precision evaluation metrics.

Precision	P@5		P@10		P@15		P@100		No Answer	
	Base	Ours	Base	Ours	Base	Ours	Base	Ours	Base	Ours
AraBERT-base	0.18	<b>0.25</b>	0.12	<b>0.20</b>	0.08	<b>0.15</b>	0.01	<b>0.06</b>	0.00	<b>0.25</b>
Roberta	0.05	<b>0.10</b>	0.04	<b>0.10</b>	0.02	<b>0.08</b>	0.01	<b>0.05</b>	0.00	<b>0.25</b>
AraBERT-large	0.18	<b>0.20</b>	0.13	<b>0.15</b>	0.09	<b>0.12</b>	0.01	<b>0.05</b>	0.00	<b>0.25</b>
Camelbert-Base	<b>0.23</b>	0.27	<b>0.19</b>	0.20	<b>0.14</b>	0.16	0.05	<b>0.09</b>	0.25	<b>0.50</b>
Araelectra-Base	0.21	<b>0.30</b>	0.18	<b>0.24</b>	0.13	<b>0.18</b>	0.05	<b>0.10</b>	0.25	<b>0.50</b>
bert-squad-accelerate	0.08	<b>0.22</b>	0.06	<b>0.18</b>	0.05	<b>0.17</b>	0.04	<b>0.13</b>	0.25	<b>0.75</b>

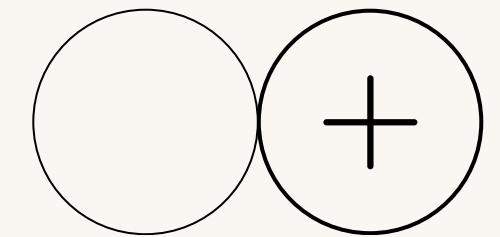
# Demo



A screenshot of a web browser window displaying the "Quran Q&A Assistant". The title bar shows the URL [www.BANDICAM.com](http://localhost:5173). The main content area features a dark green header with the text "Quran Q&A Assistant" and "Ask questions about the Holy Quran and Islamic teachings". Below this is a white input field with the placeholder "Type your question about the Quran..." and a "Ask" button. A dark green footer bar at the bottom of the page contains the text "Use this tool responsibly and verify answers with authentic Islamic sources". The browser's address bar shows the URL [localhost:5173](http://localhost:5173). The taskbar at the bottom of the screen includes icons for File Explorer, Task View, Edge, File, Mail, and others, along with system status indicators like battery level and signal strength.

# Conclusion

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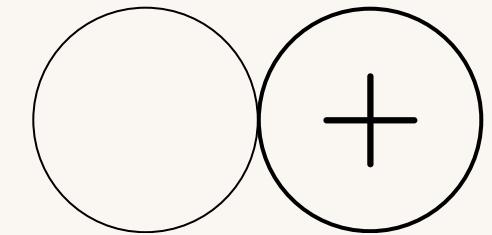


## 1 - Contributions

- Developed a Quranic question-answering model by fine-tuning LM , enabling accurate interpretation of Classical Arabic and enriching Arabic NLP research, especially for religious texts.
- Expanded existing datasets by adding diverse Quranic question-answer pairs, addressing limitations in current models and establishing a foundation for future Arabic question-answering systems.

# References

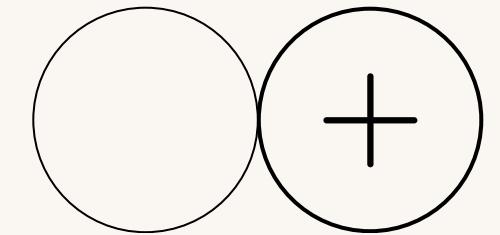
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# Any Questions ?

# Thank You!