

## Investing in Artificial Intelligence for the Digitization of Arabic Manuscripts

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### Abstract:

This study examines how artificial intelligence technologies can be used to digitize Arabic manuscripts, with a focus on promoting the preservation of Arab cultural and intellectual heritage and facilitating access to it. The study reviews the role of artificial intelligence in optical character recognition (OCR), text classification, analysis, and accurate information extraction, as well as the recognition of ancient Arabic letters and words and font analysis, highlighting the challenges

associated with digitization, such as: dealing with ancient handwriting, image quality, the difficulty of understanding some heritage vocabulary, and intellectual property protection. The results indicate that integrating artificial intelligence into digitization processes contributes to accelerating the preservation process, facilitating access for researchers, and enhancing the sustainability of Arab cultural heritage in the digital age.

**Keywords:** artificial intelligence, digitization of Arabic manuscripts, optical character recognition (OCR), text analysis, image quality.

## **Introduction:**

Manuscripts are among the most important sources of cultural and intellectual heritage for humanity, as they carry historical, intellectual, and artistic knowledge across the ages. Over time, these manuscripts face the risks of damage, deterioration, and loss, which necessitates the search for effective ways to protect them and ensure their accessibility. In light of the rapid technological revolution, artificial intelligence has become a promising tool in digitization processes, as it can process ancient and complex texts with greater speed and accuracy compared to traditional methods.

Artificial intelligence enables the visual recognition of characters, the understanding of historical texts, their classification and analysis, and even the restoration of missing parts of manuscripts. It also contributes to the creation of digital databases that are easily accessible to researchers and specialists, opening up new avenues for the study of cultural heritage and the exchange of knowledge. This study aims to discuss the importance of artificial intelligence in the process of

digitizing manuscripts, clarify its practical applications, review the challenges it faces, and suggest ways to improve the effectiveness of digitization using these modern technologies.

Before moving on to the topic of digitizing manuscripts using artificial intelligence, it is necessary to understand the nature of manuscripts, their characteristics, and the objectives and principles of their verification, as this understanding forms the basis for any accurate and effective digitization process.

## **First: Definition of manuscript verification:**

### **A. Definition of verification:**

Language: Verification in language: taken from "I verified the matter if I was certain of it or made it fixed and necessary, and the truth of the matter is its end and its origin<sup>1</sup>, and it is said that the matter is true: correct, proven, and true, and it is said

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<sup>1</sup> Ahmed Muhammad al-Fayumi, Dictionary of the Language "Kitab al-Mishbah al-Munir," Noblis, vol. 2, p. 198.

“I have verified the truth” means “I have prevailed over it and confirmed it.”<sup>1</sup>

In linguistic terms, it is said that “a garment is verified if it is well woven.”<sup>2</sup>

So verification in language means knowing something and knowing its reality with certainty.

Verified speech is well-crafted and sober.

As for the conventional meaning of verification, it is proving matters with evidence and bringing out the truth.

As Al-Jurjani says, “Verification is proving matters with evidence, and verification is explaining something truthfully.”<sup>3</sup> Those interested in verification agree that it is an independent science with its own methods and principles, and that it is no longer a relatively modern

science, as it only became clear after the emergence and development of printing and the spread of printing presses. “as research began in manuscripts and rare books to print a copy that the printer considered important,”<sup>4</sup> and we mention the most important terminological definitions of investigation as follows:

B. The purpose of the investigation: The book should be interpreted faithfully as intended by its author. The purpose of editing a book is not to seek a higher style than the original, or to replace a correct word with another on the grounds that the former is more appropriate, more beautiful, or more suitable, or to attribute a text to a speaker when the author is mistaken in this attribution. the editor corrects that error and replaces it with the correct one, or if the author makes a precise grammatical error, the editor corrects it, or if the author's wording is too concise, the editor simplifies it to avoid confusion, or if the author makes a mistake in mentioning a

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<sup>1</sup> Arabic Language Academy, Al-Mu'jam al-Wasit, Dar al-Ma'arif, Egypt, 1400 AH, vol. 1, p. 194.

<sup>2</sup> See: Ibn Faris, Maqayis al-Lugha, edited by Abd al-Salam Muhammad Harun, Dar al-Fikr,

<sup>3</sup> Damascus, Syria, 1st edition, 1979, vol. 2, (entry for “haqq”).

-Al-Jurjani, Mu'jam al-Ta'rifat, edited and studied by Muhammad Siddiq al-Manshawi, Dar al-Fadila, Cairo, 1st edition, p. 79.

-Maymuna Awni, Linguistic Studies in the First Half of the Twentieth Century, Dar Ghaida Publishing, Amman, Jo

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<sup>4</sup> Maymouna Awni, Language Lessons in the First Half of the Twentieth Century, Dar Ghaida Publishing, Amman, Jordan, 2015, p. 215.

well-known fact, the editor corrects it.”<sup>1</sup>

C. Definition of manuscripts: Before delving into the semantic concept of this term, it must be noted here that philologists do not accept the use of the term manuscript unless it is attached to the word book, so they say “the manuscript book,” because not everything that is written by hand is necessarily considered a manuscript. Grave inscriptions, stone engravings, and rock carvings cannot be considered manuscripts.

Language: The word manuscript is derived from the past tense verb “wrote” or the present tense verb “writes,” meaning to write and depict words using letters of the alphabet.

As for the term: Its definition has been mentioned in several definitions, including:

- Manuscripts are: “books written by hand, due to the absence of printing at the time of their composition. Manuscripts are primary sources of information, documented and pertaining to

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<sup>1</sup> Souriya Sharafawi, Pedagogical Memorandum: Methodological Scale for Heritage Research, Faculty of Islamic Sciences, Department of Islamic Language and Civilization, University of Batna, 2019-2020, p. 03.

the study of various subjects. A number of researchers rely wholly or partly on the information contained in manuscripts.”<sup>2</sup>

Based on the above, we can define a manuscript as a book that has not yet been printed, i.e., it is still in the author's handwriting or in the handwriting of another copyist.

Second: Qualities of the investigator:

Investigation is not an easy task; it is a journey of the diligent. If you want to be a good investigator,

you must possess certain moral and intellectual qualities, the most important of which are the following:

A. A desire to verify and a love for the subject of the manuscript: This makes the researcher approach the verification of the manuscript with love and desire, making it easier for him to overcome the difficulties he faces and making it easier for him to stay up late and work hard in pursuit of interpreting a word or checking a sentence.

B. Accuracy of observation and experience: There is no doubt that seriously editing a manuscript is more difficult than writing one, and

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<sup>2</sup> -Iyad Khaled Al-Tabbaa, The Arabic Manuscript, A Study of the Dimensions of Time and Space, Publications of the Syrian General Book Authority, Ministry of Culture, Damascus, 2011, pp. 5-6.

therefore the editor needs to be observant in identifying errors and distortions and correcting mistakes. He also needs extensive experience with the names of the people of the era and the reality of life at the time the manuscript was written, as well as with the history of the script and the circumstances of the manuscript's writing, if possible.

C. Patience, perseverance, and open-mindedness: Due to their age, circulation among many owners, and transcription by multiple copyists, manuscripts may often have some words and sentences obscured, some pages torn or worn, or be incomplete at the beginning or end, or have some pages missing. All of this requires the investigator to be patient, persevering, and tolerant as he tries to find the missing words or seeks to interpret an obscure phrase that he cannot find in the references he consults. He may spend many days doing this until he reaches his goal or comes close to it.<sup>1</sup>

D. Accuracy in transcribing texts without addition or omission.

E. Humility, openness to advice, and willingness to engage in dialogue and discussion.

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<sup>1</sup> Fahmi Saad, Talal Majzoub, *Investigating Manuscripts: Between Theory and Practice*, World of Books, Beirut, 1st edition, 1992, pp. 21-22.

F. Extensive knowledge of the Arabic language.

G. Extensive knowledge of heritage books and sources in various fields of research and knowledge.

H. The investigator must be knowledgeable and familiar with the subject of the book.

I. Knowledge of paper, ink, abbreviations, and symbols.

J. Knowledge of the principles and rules of verification and the principles of book publishing.<sup>2</sup>

Third: Rules and principles of manuscript investigation:

While Orientalists have made a significant contribution to the investigation of Arab and Islamic heritage, this does not mean that the investigation of texts is foreign to our Arab scholars, who have devised rules and principles of investigation that differ from those of the Orientalists. We arrange the rules of investigation as follows:

A. Collecting and organizing copies:

Collecting: When we want to verify an old manuscript, we must first seek to identify its numerous copies,

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<sup>2</sup> Mr. Rizk al-Tawil, *Introduction to the Principles of Scientific Research and Heritage Preservation*, Al-Azhar Heritage Library, Cairo, 2nd edition, p. 195.

which may be scattered throughout libraries around the world, to the extent possible<sup>1</sup>. This means that the researcher must obtain the most important copies of the manuscript preserved in the world before beginning the verification process<sup>2</sup>. In order to identify the location of the copies and their presence in libraries around the world, several resources must be consulted, including: Karl Brockelmann's *History of Arabic Literature*. Although the book does not cover everything, it is also advisable to refer to the indexes of Arabic manuscripts in libraries. We can also refer to Fuad Sezgin's *History of Arabic Heritage*, which is more comprehensive than Brockelmann's book, and Ramadan Shishan's book on "Rare Arabic Manuscripts in Turkish Libraries," in addition to indexes of manuscript libraries of all kinds, such as Korkis Awad's *Indexes of Arabic Manuscripts in the World*.

It should be noted here that a researcher may not be able to find all the manuscripts pertaining to a single book, because no matter how many copies he collects, there will

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<sup>1</sup> -Salah al-Din al-Manjid, *Rules for Verifying Manuscripts*, p. 12.

<sup>2</sup> -Muhammad al-Tunji, *The Methodology of Research and Manuscript Verification*, World of Books, n.p., 1986, p. 164.

always be someone who can unearth a new copy that no one knew about, which is what gives the process of verifying manuscripts its permanence and continuity.

• Order of copies: The order of copies is as follows:

- The best copy is the one written by the author in his own handwriting, as this is the original.

- A copy that the author read or had read to him, and confirmed in his own handwriting that it was read to him.

- A copy written during the author's lifetime, preferably one that has been verified by scholars, if available.

- Ensuring that the copy in our possession is the last version of the author's book.

- Other copies written after the author's lifetime, in which case the older copies are preferred over the later ones, which were written by a scholar or read to a scholar. A later copy may be preferred over an older one for other reasons (being more accurate and less distorted). As for copies that are not dated, their date must be determined based on their script, the quality of their paper and ink. In any case, it is never permissible to publish a book based on a single copy, as long as there are

other known copies, lest the book be lost if the scientific investigation and accuracy are published.

Categories: If there are many similar copies, they should be placed in categories (category A, category B, etc.), and one copy from each category should be taken to represent it when proving the differences between the copies.

B. Verification of the text Purpose and method of verification:<sup>1</sup>

The purpose of verification is to present the manuscript as it was written by its author, without explanation, by:

- Verifying the authenticity of the book and its title, and attributing it to its author.
- If the copy was written by the author in his own handwriting, it is verified as is.
- Indicating in the footnotes any additions or omissions in the text.
- Attributing what the author has quoted to its source.
- Correcting the author's errors in the footnotes, or correcting them in

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<sup>1</sup> Salah al-Din al-Manjid, Rules for Verifying Manuscripts, p. 13.

the text and noting this in the footnotes.

- If there are differences between copies, we choose one copy to be the original.
- Comparing the original copy with the other copies and noting the differences between them in the footnotes.
- When there are differences in the narrations, we confirm in the text what we believe to be correct, and we put the corrected, altered, and erroneous versions in the footnote.
- When there is an addition in a copy other than the approved copy, we verify the origin of the book, confirm it, and indicate it in the footnote.
- The investigator may insert a letter or word that has been omitted from the text, placing it in parentheses.
- If there is a tear in the manuscript that has caused some text to be lost, and this text is found in another printed or preserved book, we can complete it with a reference to this in the footnote and place it in brackets. However, if we cannot find what has been lost due to the tear, we indicate the amount of blank space in the footnote.
- A beginner in research should rely on one copy and then compare it

with other copies, giving preference to the best version.

- If additions are found, they should be added in the footnote.

- The investigator should be familiar with the symbols found in very old manuscripts.

C. Spelling: We may find old texts with neglected words that are not punctuated, so it is not correct to write them today without punctuation marks. We may also find that they do not have any hamza, fathah, kasrah, or shaddah. This leads to confusion, so emphasis should not be neglected, and the initial hamza (cut) should be placed, and the two dots should be placed under the ya to avoid

D. Abbreviated words: Sometimes we find abbreviated words in texts, such as “al-kh, raha, ta, rada.”

Here, the editor must complete the abbreviations and refer them to their origin, so we write them in succession: "to the end,

may God have mercy on him, exalted be He, may God be pleased with him."

E. Form: Scholars believe that form is one of the basic duties of the investigator in many places, such as Quranic verses, noble prophetic hadiths, proverbs, flags, topics, and

countries, as these elements are prone to ambiguity.

Therefore, the investigator must preserve what he finds ambiguous in the text, as well as the verses of the Qur'an and the noble hadiths, and clarify all words whose meaning is unclear.

F. Headings:

The headings of the chapters and sections should be written in a larger font than the text.

G. Dividing and numbering the text: This is done by:

- Preserving the author's division and order.

- If the text is not divided, we divide it and give each section a title in parentheses.

- If the text is divided, the chapters are numbered.

- If the text is in translations, put the translator's name in a smaller font than the main text on the side of the page in the margin, and number the translations.

- In hadith books, number the hadiths.

- Keep the chapters of poetry collections as they appear, or arrange the collection according to the letters

of the alphabet and number the poems and verses.

H. Brackets, lines, and symbols:

- Curly brackets are used to enclose Quranic verses ﴿﴾.
- Double commas enclose the names of books if they appear in the text «».
- Two short lines enclose parenthetical sentences - -.
- The vertical lines enclose any additions from a second copy other than the approved copy | |.
- The square brackets enclose additions from second texts, quoted or cited, and new titles [ ].

T. Footnotes: To achieve the text as written by the author, we include the differences between the copies in the footnotes, followed by comments, separating them with a line. This is the method used by some German Orientalists. After mentioning the differences between the copies, we also mention the sources of the text or those referred to by the investigator. In this regard, we refer to:

the sources of quotations, Quranic verses by number and surah, prophetic hadiths by their mentioned source, notices and evidence, and we refer to their sources in detail.

Footnotes: To convey the text as written by the author, we include differences between copies in the footnotes, followed by comments, separating them with a line. This is the method used by some German Orientalists. After noting the differences between copies, we mention the sources of the text or those referred to by the editor. In this regard, we refer to:

the sources of quotations, Quranic verses with their numbers and surahs, prophetic hadiths with their sources, notices and evidence, and we indicate their sources in detail.

J. Indexes: These are the key to the book, "Their purpose is to facilitate the use of everything contained in the published book and make it accessible to every researcher. They vary according to the subject of the book, although there are indexes that are almost always found in literary, historical, and linguistic books, such as indexes of famous people, places and countries, poetry, etc.

K. Introduction: This includes a comprehensive biography of the author of the book, a statement about the value and usefulness of the book in its field, with attention paid to showing its influence on others and its impact on those who followed it. This is followed by a description of the manuscripts of this book that

exist in the world and a statement of what the editor relied on from them to produce the text.<sup>1</sup>

L. List of references: The editor concludes the book with a list of references used during the editing process.

However, despite the importance of the principles and rules of manuscript verification in preserving their authenticity and accuracy, this process is labor-intensive and complex, requiring careful study of the texts, comparison of different copies, correction of errors, and documentation of amendments. Hence, artificial intelligence has become a vital tool for facilitating these tedious tasks, as it enables optical character recognition, text classification, and rapid and accurate analysis, thereby reducing the burden on researchers and ensuring the preservation of cultural and intellectual heritage more efficiently.

Although we have referred to the rules and principles of manuscript verification and their importance in producing an accurate and reliable text, applying these rules is

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<sup>1</sup> -Ramadan Abd al-Tawwab, *Approaches to Heritage Research Among the Ancients and Modern Scholars*, Al-Khanji Library, Cairo, 1st edition, 1985, p. 175.

extremely laborious work. It requires great patience in reading ancient scripts, comparing copies, adjusting the text, and verifying words. Because of the great effort and difficulty involved in the verification process, resorting to modern technologies such as artificial intelligence becomes a necessary step to facilitate the work and ease the burden on the researcher.

There are many areas of application for artificial intelligence, including:

- Systems for simultaneous translation between one language and another, or between a group of languages at the same time.
- Reading machines that convert written text into spoken language.
- Intelligent information retrieval....

Fifth: Artificial intelligence and its role in rewriting manuscripts:

Artificial intelligence plays an important role in transcribing ancient Arabic manuscripts through a set of advanced technologies that contribute to preserving this heritage and making it available to scholars. The most important of these roles can be summarized as follows:<sup>2</sup>

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<https://digtechvision.blogspot.com/2024/05/ai-preserving-cultural-heritage.html>

1. Recognizing ancient texts: Natural language processing algorithms help read the handwriting found in historical manuscripts. By training models on ancient Arabic calligraphy styles, artificial intelligence becomes capable of recognizing texts written in complex scripts or those whose clarity has been compromised by the passage of time.
2. Converting handwriting into digital text: After recognizing the written content, artificial intelligence converts it into digital text that can be read and processed. This facilitates the process of searching, investigating, and comparing different copies, and allows researchers around the world to easily access these texts.
3. Translation of ancient texts: Artificial intelligence also offers effective solutions for translating manuscripts into other languages. Thanks to neural machine translation technologies, translations can be obtained that are closer to accuracy and preserve the original meaning as much as possible, thereby expanding the circle of beneficiaries of Arab heritage.
4. Analyzing and understanding texts: The role of artificial intelligence is not limited to reading and conversion, but extends to analyzing texts to reveal their themes,

vocabulary, and style. It can also provide a deeper understanding of the historical and cultural contexts of the text, helping researchers to study manuscripts more comprehensively.

Sixth: Recognizing manuscript characters using artificial intelligence

1. Pre-processing: After converting the manuscript into a digital image, several preliminary steps are taken before character recognition, including:

- Text Localization: Identifying the locations of text within the image.
- Noise Removal: Cleaning the paper of defects or distortions resulting from digital conversion.
- Representing the image in black and white instead of grayscale and colors, which is known as binarization, where only two values are used for each image element (usually represented by zero and one), one representing dark areas such as ink and the other representing light areas such as the page background.
- Binarization: Converting the image to black and white to distinguish the ink from the background of the page.

2. Correcting writing deviation: Adjusting the angle of the text to make it straight using techniques often based on projections (the sum of the dark image elements in each column or line of the image) or text structuring: .... These processes prepare the digital image to facilitate more accurate automatic character recognition.<sup>1</sup>

3. Segmentation: Segmentation refers to the process of separating the written text into individual characters, so that each character is placed in a separate matrix, in preparation for extracting the characteristics specific to each character. This stage is considered one of the most difficult and important, as it directly affects the accuracy of text recognition. The segmentation process is usually divided into several sequential steps to ensure that characters are accurately separated and prepared for subsequent analysis:<sup>2</sup>

- Divide the document into lines.

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<sup>1</sup> See: Youssef Salem Al-Aryan et al., Applications of Artificial Intelligence in the Service of the Arabic Language, Dar Wajoh Publishing and Distribution, Riyadh, 2019, pp. 21-22.

<sup>2</sup> Rua Abu Al-Shamat, Automatic Recognition of Arabic Characters by Extracting Their Structural Features, Tishreen University Journal for Scientific Research and Studies, Engineering Sciences Series, (36)6, 2014, p. 519.

- Find the font weight and font size.
- Divide each line into the words that make it up.
- Divide each independent word within each line into its syllables.
- Divide each syllable of the word into the letters that make it up.
- Identify abnormal segmentation cases:<sup>3</sup>

4. Feature extraction: Many systems resort to representing the images to be recognized in a concise and focused manner, by extracting their most important features, in order to reduce the amount of data and speed up processing time, focusing on the essential elements of the text and ignoring secondary details such as individual font differences. Although designing and selecting the appropriate features requires expertise, experience, reflection, and creativity, there is general agreement on the basic characteristics that these features should have to ensure

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<sup>3</sup> See: Youssef Salem Al-Aryan et al., Applications of Intelligence Alal Ali, Moussa Abdel Wahab, Artificial Intelligence for Identifying Historical Manuscripts and Its Role in Developing Heritage Tourism, Journal of Advanced Economic Research, Volume 10, Issue 2025, pp. 341-3

accurate character recognition, the most important of which are:

-Ignoring differences in the writing of a single letter as much as possible, as there will inevitably be differences between writers in their drawing of letters, and even the same writer may draw letters differently from one time to another. The appropriate feature is less affected by these individual differences.

-It should show the differences between multiple letters, reflecting differences in the shapes of the letters sin, shin, and ha, for example.

-The features should be as unaffected as possible by the size of the writing, slight slanting or turning, or the flow of the writing :<sup>1</sup>

5. Classification: The classification process, also known as recognition, aims to identify the text code based on its characteristics after learning from previous examples. The classification process usually goes through several basic stages:

- Modeling and Training: In this stage, the classifier is given labeled examples of the words or characters to be recognized. Using learning algorithms, the system “learns” to

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<sup>1</sup> See: Youssef Salem Al-Aryan et al., Applications of Artificial Intelligence, p. 26.

associate features with texts, resulting in a model that can be used later in the recognition stage.

- Recognition: This is the final stage that interests the user, where the classifier uses the model to extract characters or texts from new data, without the need for prior labeling.

- Testing: After the recognition model is ready, the testing phase is used to measure the accuracy of the system on characters or texts that have not been previously labeled. The results are compared with the original labels to determine success and error rates, which may include:

- o Insertion Errors

- o Deletion Errors

- o Substitution Errors

- Validation Phase:

Sometimes used to improve model training and fine-tune its performance before the final testing phase.<sup>2</sup>

In summary, these phases show the classification process from the system learning on examples to

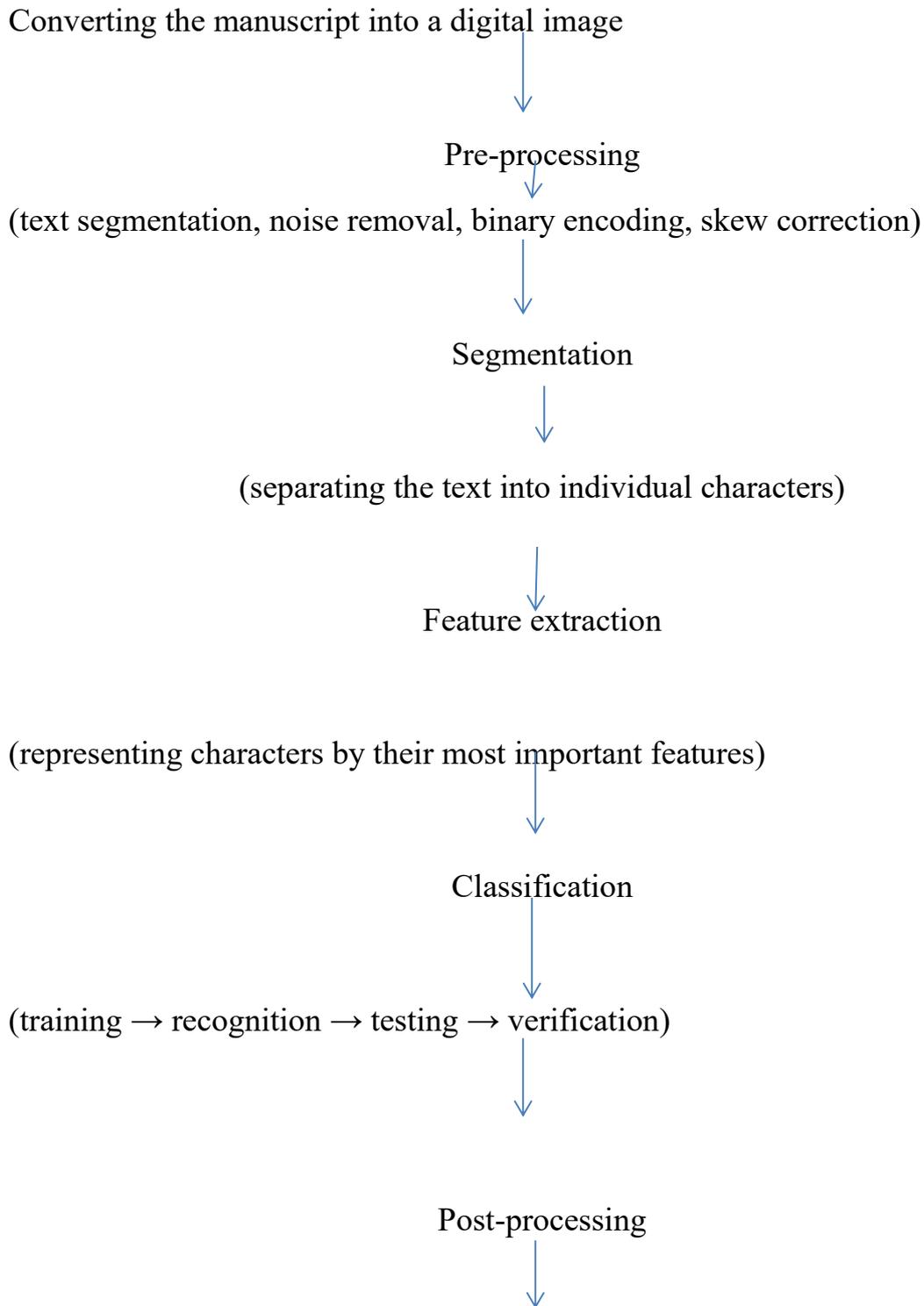
Tagged, leading to the recognition of new texts and the measurement of the accuracy of the results compared to the original.

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<sup>2</sup> See, *ibid.*, pp. 27–28.

- Post-processing: This relies on dictionaries, linguistic rules, or the content of the manuscript to correct errors resulting from automatic recognition and adjust the final text by accepting or rejecting inaccurate results, especially when the words to be recognized are related to a specific field or specialty.

We can summarize what we have discussed in the following diagram:



(error correction, use of dictionaries and grammar rules, final text adjustment)



Final digital text

### Diagram illustrating the stages of automatic manuscript recognition

#### Conclusion:

The process of automatic recognition of Arabic manuscripts demonstrates the importance of integrating several complementary stages, from pre-processing and segmentation, through feature extraction and classification, to post-processing, in order to ensure the accuracy of the final digital text. It also highlights the role of artificial intelligence in improving recognition speed and reducing errors, especially when dealing with complex or specialized texts. This process not only preserves manuscript heritage, but also enables researchers to study its content more effectively and disseminate Arabic knowledge more widely.

#### List of sources and references:

1. Ibn Faris, *Maqayis al-Lugha*, edited by Abd al-Salam Muhammad Harun, Dar al-Fikr, Damascus, Syria, 1st edition, 1979, vol. 2.
2. Ahmad Muhammad al-Fayumi, *Dictionary of the Language*, *Kitab al-Mishbah al-Munir*, Noblis, vol. 2.
3. Al-Asbahani, Al-Aghani, edited by a committee of writers,

Dar al-Thaqafa, Beirut, 6th edition, 1983, vol. 2.

4. Iyad Khalid al-Tabba, *Al-Makhzun al-Arabi*, a study of the dimensions of time and place, published by the Syrian General Book Authority, Ministry of Culture, Damascus, 2011.

5. Al-Jurjani, *Dictionary of Definitions*, edited and studied by Muhammad Siddiq al-Manshawi, Dar al-Fadila, Cairo, 1st edition.

6. Ramadan Abd al-Tawwab, *Approaches to Heritage Research among the Ancients and Moderns*, Al-Khanji Library, Cairo, 1st edition, 1985.

7. Rua'a Abu al-Shamat, *Automatic Recognition of Arabic Characters by Extracting Their Structural Features*, *Tishreen University Journal for Scientific Research and Studies*, Engineering Sciences Series, (36)6, 2014.

8. Sayyid Rizq al-Tawil, *Introduction to the Principles of Scientific Research and Heritage Research*, Al-Azhar Heritage Library, Cairo, 2nd edition, n.d.

9. Souriya Sharafawi, Pedagogical Memorandum: Methodological Scale for Heritage Research, Faculty of Islamic Sciences, Department of Islamic Language and Civilization, University of Batna, 2019-2020.
10. Abdelmajid Diab, Researching Arab Heritage: Methodology and Development, Dar Al-Ma'arif, Cairo, 2nd edition, 1993.
11. Abdelwahab Mohamed Ali, Amali Mustafa Jawad Al-Bayati, On the Art of Text Research, research published in Al-Mawrid magazine, issue 1, 1977.
12. Allal Ali, Moussa Abdel Wahab, Artificial Intelligence for Identifying Historical Manuscripts and Its Role in the Development of Heritage Tourism, Journal of Advanced Economic Research, Vol. 10, No. 2025 01.
13. Fahmi Saad, Talal Majzoub, Verification of Manuscripts: Theory and Practice, World of Books, Beirut, 1st edition, 1992.
14. Kazim Ahmed, Artificial Intelligence, Faculty of Information Technology, Imam Al-Sadiq University, Sudan, 2012.
15. Arabic Language Academy, Al-Mu'jam Al-Wasit, Dar Al-Ma'arif, Egypt, 1400 AH, Vol. 1.
16. Mohammed Al-Tunji, The Methodology of Research Writing and Manuscript Verification, World of Books, n.d., 1986.
17. Mohammed Majmad Al-Hadi, E-Learning via the Internet, Egyptian Lebanese Publishing House, 2005.
18. Maymouna Awni, Linguistic Lessons in the First Half of the Twentieth Century, Dar Ghaida Publishing, Amman, Jordan, n.d. 2015.
19. Yusuf Salem Al-Aryan et al., Applications of Artificial Intelligence in the Service of the Arabic Language, Dar Wajoh Publishing and Distribution, Riyadh, 2019.
20. Alexander V.M amishey, technical writing for teams: the stream Tools Handlook 1st Edition.
21. The fine art of copyediting, Elsie M. stainton, 2<sup>nd</sup> ed.
22. Rewriting ancient Arabic manuscripts with artificial intelligence  
<https://digtechvision.blogspot.com/2024/05/ai-preserving-cultural-heritage.html>