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## PERFORMANCE OF NEURAL MACHINE TRANSLATION TOOLS IN TRANSLATING ARABIC NON-DIACRITIZED TERMS: A CASE STUDY OF ALGERIAN FAMILY CODE

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### Abstract

This paper aims to evaluate the output of three machine translation tools that rely on the neural approach and artificial intelligence. It seeks to measure the performance of these tools in rendering Arabic non-diacritized legal words extracted from the *Algerian Family Code*, originally written in Arabic. To achieve this, a sample of ten passages containing Arabic non-diacritized terms was selected. The criteria for selecting the passages were based on the inclusion of words that have multiple meanings depending on the diacritics applied to their letters. The samples were given to three different neural machine translation tools to be translated from Arabic to English, and the results were then compared according to the error rate of each tool. The error classification focused on semantic accuracy and contextual adequacy, grouping errors into three categories: semantic (distortion of meaning), omission (failure to render key terms), and cultural (loss of legal or culture-bound nuances). The case study showed varying results for the three machine translation tools. It demonstrated the ability of neural machine translation to disambiguate the correct meaning of Arabic terms from context, even in the absence of diacritical marks.

**Keywords:** neural machine translation, artificial intelligence, legal texts, Algerian Family Code, diacritics

### 1.Introduction

In recent years, the field of machine translation has witnessed major developments, particularly with the emergence of neural machine translation (NMT), which has reshaped earlier assumptions and beliefs about the limitations of this technology.

Today, machine translation is widely used among translators and professionals due to its efficiency and speed in handling various types of texts. In fact, it is estimated that machine translation systems process around 143 billion words per day—approximately 150 times more than all human translators combined can achieve in a single day (Pym & Torres-Simon, 2021, p. 2). Furthermore, neural machine translation tools can translate from and between many of

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the world's languages: Google Translate, for example, supports 243 languages (Whitney, 2024); Bing Translator covers more than 100 languages (Microsoft, 2021); and Systran Translator offers translation in 55 languages (Systransoft, 2024).

Arabic, being one of the languages supported by neural machine translation tools, has increasingly attracted the attention of MT engineers due to its large number of speakers—estimated at nearly 400 million worldwide (Alnosairee, 2021). However, the Arabic language system is unique in its use of *tashkil*, i.e., diacritics, which serve as guiding marks indicating the precise pronunciation of words and defining their grammatical functions (Hallberg, 2022, p. 4).

The presence of Arabic diacritics is crucial in many types of texts, especially sacred texts such as the Qur'an and sensitive genres such as legal texts, where misinterpretation may lead to legal disputes or liabilities. Nevertheless, a large proportion of Arabic writing appears without diacritics, as disambiguation is often possible through contextual inference (Mubarak et al., 2019, p. 217). However, machine translation tools may face challenges when processing Arabic words that share the same orthographic form but differ in meaning depending on the diacritic placed above or below each letter. Such tools may struggle to select the correct equivalent, particularly for words with multiple potential meanings. For instance, the Arabic term *قدم*(*qadam*), literally meaning “foot,” may have several meanings when written without diacritics. According to Almaany (2024), it may mean *قَدِمَ*(*to come*), *قَدَّمَ*(*to offer*), *قَدُمَ*(*to become old*), or *قَدَمٌ*(*foot*).

This study aims to evaluate the performance of neural machine translation tools in translating non-diacritized Arabic legal terms extracted from the Algerian *Family Code*. It further seeks to compare three different neural machine translation tools and to examine their differences by addressing the following research questions:

- Are neural machine translation tools able to translate non-diacritized Arabic legal terms correctly?
- To what extent can neural machine translation tools simulate human reasoning and infer the meaning of non-diacritized Arabic legal terms from context?
- Is there any variation in the efficiency of NMT tools in translating non-diacritized Arabic legal terms?

To answer these questions, the following hypotheses were proposed:

- Neural machine translation tools may successfully translate some non-diacritized Arabic legal terms while failing to translate others.
- Neural machine translation tools may infer the meaning of non-diacritized Arabic legal terms from context through deep learning structures and algorithms such as the attention mechanism.
- The performance of neural machine translation tools may vary according to the training data and database of each system.

## 2. Literature review

The performance and efficiency of machine translation (MT) have attracted significant scholarly attention in recent years. This technology is capable of translating thousands of words within seconds and assisting linguists and translators in their professional activities. Nevertheless, MT systems must be evaluated regularly by experts—either through human judgment or automatic metrics—to ensure continuous improvement and reliability (Freitag et al., 2021, p. 1). Several studies have examined MT performance in Arabic–English translation, given the linguistic complexity and structural divergence between the two languages.

Hadla, Hailat, and Al-Kabi (2014) evaluated the efficiency of two online MT tools, Google Translate and Babylon, using the BLEU metric—a widely used algorithm for assessing MT quality (Reiter, 2018). Their corpus consisted of 1,000 Arabic sentences and their corresponding English translations. The study concluded that Arabic posed substantial challenges to MT systems, particularly in terms of morphological richness and syntactic variation. Although Google Translate slightly outperformed Babylon in precision, both systems demonstrated considerable limitations. It is worth noting that these tools operated under the statistical machine translation (SMT) paradigm, which has since been replaced by neural machine translation (NMT) due to the latter's superior performance in producing more fluent and contextually appropriate translations.

In a more recent study, Stiti and Benaouda (2023) conducted a human evaluation of Google Translate's output when rendering four Algerian legal codes into English. Errors were categorized according to linguistic levels—lexical, semantic, syntactic, and pragmatic. The results revealed that while Google Translate performed relatively well at the lexical and syntactic levels, it struggled significantly with semantic and pragmatic aspects, particularly in rendering culture- and religion-specific legal expressions. However, the authors observed that the amount of post-editing required had decreased compared with earlier evaluations, suggesting gradual improvement in MT performance.

Another relevant study by Saleh and Tagadeen (2023) investigated the impact of Arabic diacritics on MT performance using Yemeni proverbs as a corpus. Passages containing diacritized homographs were translated by three MT tools—Systran Translate, Reverso Translate, and Free Translation Online and analyzed based on error rates. The results revealed high levels of mistranslation across all systems: Systran failed to correctly translate any of the samples, while Reverso and Free Translation Online recorded error rates of 75 % and 66.6 %, respectively. These findings suggest that, even when diacritical marks are present, MT systems often fail to correctly interpret them, highlighting persistent weaknesses in handling the morphological and phonological subtleties of Arabic.

Collectively, the reviewed studies point to persistent challenges in Arabic–English MT, including inadequate semantic disambiguation, poor handling of cultural and legal nuances, and limited sensitivity to diacritical variation. Although notable progress has been made through neural architectures, MT output still falls short of human translation quality, particularly for complex or context-dependent texts. The present study aims to build on this body of research by adopting a different perspective—examining how neural MT tools handle non-diacritized Arabic legal texts from the *Algerian Family Code*. By focusing on contextual

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inference rather than explicit orthographic cues, this study seeks to shed light on the extent to which neural systems can approximate human-like contextual reasoning in the legal translation domain.

### 3. Arabic Diacritics

Diacritics are marks or symbols placed above or below letters to guide correct spelling and pronunciation (Layla, 2018, p. 2). They can alter the meaning and pronunciation of words entirely. Such marks are used in several languages—for instance, è, ç, and ï in French; ö and ş in Turkish; or ü in German (Trask, 1997). In Arabic, this feature is called *tashkil* (literally “taking shape”). Unlike other languages, Arabic diacritics can modify not only pronunciation but also grammatical function—changing a word from the nominative to the accusative case, or even shifting the verb from the active to the passive voice. For example, the passive in Arabic is formed simply by changing the diacritical mark from a *fathah* (ـَ) above the first letter to a *dammah* (ـُ).

Arabic employs eight types of diacritics (Hallberg, 2022, p. 5), which serve as indicators of correct pronunciation: *fathah*, *kasrah*, *dammah*, *tanwin* (with three types: *tanwin fath*, *tanwin kasr*, *tanwin damm*), *shaddah*, and *sukun*.

#### 3.1 The Fathah

The *fathah* in Arabic is a small diagonal stroke (ـَ) placed above the letter, indicating a short vowel sound similar to the English /ə/. For instance, adding a *fathah* to /b/ produces [bə].

#### 3.2 The Dammah

The *dammah* (ـُ) is a small curl above the letter representing the vowel /u/. Thus, /b/ with a *dammah* is pronounced [bu].

#### 3.3 The Kasrah

The *kasrah* (ـِ) is a small diagonal stroke placed below the letter to indicate a short /i/ vowel, similar to the English [ɪ]. For instance, /b/ with a *kasrah* is pronounced [bi].

However, these three marks affect not only pronunciation but also meaning. For example, the word “كتب” (*ktb*) may take different meanings depending on the diacritics used. With *fathah* on each letter—“كَتَبَ”—it means “he wrote.” With *kasrah* on the second letter—“كُتِبَ”—it means “it was written” (passive). With *dammah* on the first two letters—“كُتُبَ”—it means “books.”

#### 3.4 The Tanwin (Nunation)

*Tanwin* in Arabic has three forms corresponding to the main short vowels. It consists of doubling the *fathah*, *kasrah*, or *dammah* and primarily serves to distinguish nouns from other parts of speech (Ibnulyemen Arabic, 2024). Phonetically, it produces [ən] for *tanwin fath*, [in] for *tanwin kasr*, and [un] for *tanwin damm*.

#### 3.5 The Shaddah

The *shaddah* (ّ), resembling a small letter w, is placed above a consonant to indicate gemination, or doubling of the consonant (Hallberg, 2022, p. 5). It is equivalent to placing stress in English and reflects the merging of two identical consonants into one, marked with the *shaddah* for brevity and aesthetics. For instance, the Arabic word “الطَّعام” (“food”) is originally “الططعام,” but the doubled letter is represented by a single consonant plus *shaddah* (Arabic Path, 2021).

### 3.6 The Sukun

The *sukun* (◌ْ) is a small circle above the letter indicating that it carries no vowel sound—it is “sakin,” or vowelless (Greer, 2024). It plays a crucial role in pronunciation and meaning. For example, “نَفْس” with *sukun* on the second letter means “soul,” whereas with a *fathah* on the same letter (“نَفَس”), it means “breath.” Such distinctions pose real challenges not only for learners of Arabic but also for machine translation systems, which must infer meaning from context when diacritics are absent.

## 4. Challenges of Translating Legal Texts

Since this study focuses on legal texts, it is essential to outline the challenges faced by both human translators and machine translation systems in rendering such texts accurately. Legal discourse deals with the domain of law (Rotman, 1996, p. 189), requiring exceptional precision and clarity to convey rules, protect rights, and ensure justice. Legal language is also performative in nature (Więclawska, 2015, p. 2)—it does not merely describe facts but performs acts such as imposing obligations, granting permissions, or expressing prohibitions.

A major challenge in legal translation involves *culture-specific terminology* (El-Farahaty, 2016, p. 482), which often lacks direct equivalents in the target language. This is particularly evident in texts derived from Islamic law, such as the Algerian Family Code. For instance, the Arabic term “خطبة” (khitbah) (Nurul Aqidatul, Sakka, & Aisyah, 2025 p. 1749) refers to the promise of marriage, commonly translated as “engagement.” However, in Islamic context, it implies the need for parental consent and other religious conditions—meanings often lost in translation.

Translators also face difficulties arising from differences among legal systems (Cosmulescu, 2021, p. 141). Legal texts follow the drafting conventions of their respective jurisdictions. Globally, five main legal systems exist: civil law, common law, customary law, religious law, and hybrid or mixed systems (OpenStax, 2024). For example, common law—found in English-speaking countries such as the United States and the United Kingdom—is based on precedent and judicial decisions, whereas civil law systems rely on codified statutes and decrees defining rights and obligations.

Some countries adopt hybrid systems. Algeria, for instance, follows a civil law tradition but integrates principles from Islamic Sharia in its family and personal status codes (LegalCommunityMENA, 2023). Similarly, the Philippines operates under multiple systems, combining Sharia, civil, and common law frameworks (OpenStax, 2024).

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Therefore, these contextual, cultural, and systemic factors must be taken into account when translating legal texts or evaluating machine translation outputs—especially in the era of neural machine translation, which, despite remarkable progress, continues to struggle with context-sensitive and culture-bound legal terminology.

### 5. Neural machine translation

Machine translation (MT) has been gaining increasing interest among translators, linguists, and even lay users due to its free and easy accessibility, as well as its speed and relatively high-quality results. However, MT has undergone several developmental phases before reaching its current stage, which is largely based on the neural approach. Most MT tools and language service providers shifted rapidly toward neural machine translation (NMT) only a few months after its emergence, thereby surpassing the earlier paradigm of statistical machine translation (SMT), which had dominated the MT market for a long period (Álvarez, Badia, & Oliver, 2021, p. 33). NMT achieved superior performance by relying on artificial neural networks that emulate certain cognitive processes of the human brain. Both automatic metrics and human evaluations confirmed that NMT consistently outperformed SMT in terms of fluency and adequacy (Álvarez, Badia, & Oliver, 2021, p. 36).

Furthermore, Escribe (2019, p. 37) conducted a human evaluation of NMT output in the context of the first book ever translated entirely by a machine translation tool. *Deep Learning* was translated by DeepL from English into French in 2018 and later published after post-editing the raw output (Escribe, 2019, p. 38). The study compared the post-edited version with the raw machine output to assess MT's overall efficiency. The results indicated that although the translation contained several errors, the unedited output was largely intelligible and acceptable to a certain degree. This finding represents a significant step forward in demonstrating the potential of NMT tools to handle extended and complex translation projects within a remarkably short time. Nonetheless, the persistence of certain errors highlights that while NMT has narrowed the gap between human and machine translation, it still falls short of achieving full semantic precision and contextual sensitivity—especially in specialized domains such as legal or literary translation.

### 6. Methodology

To address the research questions, this study adopted a comparative analytical approach based on the human evaluation of neural machine translation (NMT) outputs. Ten passages were extracted from the *Algerian Family Code*, originally drafted in Arabic. The selected passages contain ambiguous legal terms whose meanings vary depending on the diacritical marks placed above or below their letters. This deliberate selection enabled the examination of each system's ability to infer meaning from context in the absence of diacritics—a core challenge in translating Arabic legal discourse.

Each passage was translated into English using three NMT tools: Google Translate, Bing Translator, and Systran Translator. These tools were chosen because they are among the most widely used commercial translation systems that employ neural architectures. Their inclusion allows for a comparative assessment not only of translation accuracy but also of the degree to which each system handles linguistic ambiguity and contextual reasoning.

The translated outputs were then subjected to a quantitative and qualitative error analysis, focusing on the identification and classification of semantic, omission, and cultural/contextual errors. This approach was designed to measure both the efficiency (accuracy and coherence) and the performance (contextual understanding) of each system. Only non-diacritized Arabic samples were used in order to test the capacity of the NMT tools to disambiguate lexical meaning through contextual cues, rather than relying on explicit orthographic indicators.

Although the study focuses primarily on translation quality, it also recognizes the limitations inherent in evaluating black-box systems such as commercial NMT tools, whose training data and internal algorithms are not publicly accessible. Therefore, the analysis emphasizes observable performance and error typology rather than internal processing mechanisms.

## 7. Data analysis

### Example 01

|                     |                                                                                  |                                                            |
|---------------------|----------------------------------------------------------------------------------|------------------------------------------------------------|
| Source text         | المادة 5: الخطبة وعد بالزواج.<br>Literally: Engagement is a promise of marriage. |                                                            |
| Machine translation | Google Translate                                                                 | Article 5: <i>Engagement</i> is a promise to marry.        |
|                     | Bing Translator                                                                  | Article 5: <i>The engagement</i> is a promise of marriage. |
|                     | Systran Translator                                                               | Article 5: <i>Engagement</i> is a promise of marriage      |

The example above defines *engagement* using the Arabic word "خطبة", which literally means *engagement* when diacritized with a *kasrah* below the letter خ (Nurul Aqidatul, Sakka, & Aisyah, 2025 p. 1749). However, the same word may convey a different meaning in English when diacritized with a *dammah* above the same letter, in which case it means *sermon* (Almaany, 2024), as in the Friday sermon delivered by an imam.

The term "خطبة" thus poses a potential challenge for neural machine translation (NMT) systems, since it appears without any diacritical marks in the *Algerian Family Code*. This requires the system to rely solely on contextual cues to infer meaning—a process that often tests the model's capacity for semantic disambiguation.

For this instance, the three NMT tools Google Translate, Bing Translator, and Systran Translator were all able to identify the correct sense and render the term accurately as *engagement*. According to the study's evaluation framework, this translation was classified as

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semantically accurate and contextually appropriate, with no omission or distortion of meaning observed.

### Example 02:

|                     |                                                                                                                                                       |                                                                                   |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|
| Source text         | المادة 14: الصداق هو ما يدفع <u>نحلة</u> للزوجة من نقود أو غيرها.<br>Literally: Dowry is the money or other things given to the wife with good heart. |                                                                                   |
| Machine translation | Google Translate                                                                                                                                      | Article 14: The dowry is <i>what is paid</i> to the wife in cash or other things. |
|                     | Bing Translator                                                                                                                                       | Article 14: Dowry is what <i>a bee</i> pays the wife money or other things.       |
|                     | Systran Translator                                                                                                                                    | Article 14: Alms pays a bee to a wife for money or other legal things.            |

The example above emphasizes the cultural and religious significance of the *ṣadaq* (dowry), which is given to the wife as a gift and must be offered *graciously* (نحلة) (Mian Zafar, 2020, p. 1). The *Algerian Family Code* employs this term, rooted in Islamic *sharia*, to convey that the dowry should be given graciously and as a gift.

However, the Arabic term "نحلة" poses a potential challenge for neural machine translation systems. When diacritized with a *kasrah* below the initial letter ن, it means *graciously* or *as a gift*. Yet, when diacritized with a *fathah* above the same letter, it means *bee*, the insect that produces honey (Almaany, 2024). Since the text in the *Family Code* is undiacritized, the intended meaning must be inferred contextually rather than orthographically.

In this case, the three NMT systems failed to infer the correct sense. Google Translate omitted the word entirely, resulting in an omission error, while Bing and Systran both rendered نحلة as *bee*, producing a semantic error that distorted the legal and cultural meaning of the sentence. According to the study's evaluation criteria, this instance demonstrates a failure of contextual disambiguation, as the systems were unable to rely on surrounding context (...الصداق هو ما يدفع) to determine the appropriate interpretation.

### Example 03

|             |                                                                                                                                                                                                                                                                 |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Source text | المادة 62 : الحضانة هي رعاية الولد وتعليمه والقيام بتربيته على دين أبيه والسهر على حمايته وحفظه صحة وخلقاً.<br>Literally : Custody is the maintenance and education of the child, his upbringing upon the religion of his father, preserving and protecting his |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|                     |                    |                                                                                                                                                                                                                |
|---------------------|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                     | health and morals. |                                                                                                                                                                                                                |
| Machine translation | Google Translate   | Article 62: Custody is the care and education of the child, raising him according to his father's religion, and ensuring his protection and preservation of his health and <i>morals</i> .                     |
|                     | Bing Translator    | Article 62: Custody is the care of the child, his education, raising him according to his father's religion, and ensuring his protection and preservation of health and <i>morals</i> .                        |
|                     | Systran Translator | Article 62: Custody is the care and education of a child, the upbringing of a child to his or her father's religion, the protection of the child and the preservation of his or her health and <i>morals</i> . |

This example defines *custody (hadana)* as encompassing the physical, moral, and religious care of the child. The article uses the Arabic term "خلقا", which carries multiple possible meanings depending on the diacritical marks applied to it. When diacritized with a *dammah* above the first letter خ, it denotes *morals* or *ethics*, aligning with the intended sense in this legal context (Almaany, 2024). However, when diacritized with a *fathah* above the same letter, it yields the meaning *creation* (as in *Surah al-Qur'an*, 2024).

Since the text of the *Algerian Family Code* is undiacritized, the absence of diacritics presents a potential challenge for neural machine translation (NMT) systems, which must infer meaning from contextual cues rather than orthographic markers. Despite this, all three systems successfully identified the intended meaning, rendering "خلقا" as *morals*, which demonstrates effective contextual disambiguation.

From an evaluative perspective, this instance illustrates a successful case of semantic precision across all three systems. No semantic, omission, or cultural-contextual errors were detected.

#### Example 04

|                     |                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                     |
|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Source text         | <p>المادة 70 : تسقط حضانة الجدة أو الخالة إذا سكنت بمحضونها مع أم المحضون المتزوجة بغير قريب محرم.</p> <p>Literally: The maternal grandmother or maternal aunt is deprived of her right of custody if she comes to live with the mother of the child in care who has remarried a non-mahram relative..</p> |                                                                                                                                                                     |
| Machine translation | Google Translate                                                                                                                                                                                                                                                                                           | Article 70: The custody of the grandmother or aunt shall be forfeited if she lives with her child in her custody with the mother of the child in her custody who is |

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|  |                    |                                                                                                                                                                                                                     |
|--|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | Bing Translator    | married to someone other than a <i>mahram relative</i> .<br>Article 70: The custody of a grandmother or aunt shall be forfeited if she lives with the mother of the child married to a <i>non-mahram relative</i> . |
|  | Systran Translator | Article 70: The nursery of a grandmother or aunt who lives with her mother who is married to a <i>close relative</i> is usually out of place.                                                                       |

This example discusses a legal condition under which the *hadana* (custody) of a grandmother or aunt is forfeited if she resides with the mother of the child who has remarried a non-mahram man. The Arabic term "محرم" is deeply rooted in Islamic law and denotes a man whom a woman is permanently forbidden to marry due to blood ties, marital relations, or breastfeeding (GIWPS, 2022).

From a linguistic perspective, the term is polysemous and context-dependent. When diacritized with a *dammah* on the first letter and a *shaddah* on the third (مُحَرَّم), it refers to *Muḥarram*, the first month of the Islamic calendar. However, when diacritized with a *fathah* on the first and fourth letters (مَحْرَم), it signifies *mahram*, denoting a person a woman cannot marry — the intended meaning in this legal article (Almaany, 2024; Oxford Dictionary, 2024).

Because the Algerian Family Code omits diacritical marks, this term presents potential ambiguity for machine translation systems. The analysis shows that Bing Translator and Google Translator both succeeded in disambiguating the term correctly, rendering it as *mahram* — a strategy of borrowing that reflects awareness of Islamic legal terminology in English discourse. In contrast, Systran Translator produced a semantically incoherent and contextually irrelevant output ("nursery ... out of place"), which constitutes a semantic and cultural-contextual error.

This case underscores the varying degrees of contextual reasoning among NMT systems and highlights that successful disambiguation of non-diacritized Arabic legal terms often depends on a system's exposure to culturally and religiously embedded terminology in its training data.

### Example 05

|             |                                                                                                                                                                                                                                                                                                                                     |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Source text | المادة 79: يراعي القاضي في تقدير النفقة حال الطرفين وظروف المعاش ولا يبرأه تقديره قبل مضي سنة من الحكم.<br><br>Literally: In assessing maintenance, the judge takes into account the spouses' situation and living conditions. This assessment may not be called into question before one year has passed from the pronouncement of |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|                     | the judgment.      |                                                                                                                                                                                                                                   |
|---------------------|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Machine translation | Google Translate   | Article 79: When estimating the alimony, the judge shall take into account the circumstances of both parties and the living conditions, <i>and shall not review his estimation</i> before one year has passed from the ruling.    |
|                     | Bing Translator    | Article 79: In assessing alimony, the judge shall take into account the situation of both parties and the circumstances of the pension and <i>shall not review his assessment</i> before the lapse of one year from the judgment. |
|                     | Systran Translator | Article (79): The judge shall take into account the circumstances of the parties and the pension <i>and shall not review his assessment before</i> the completion of a year of the judgment.                                      |

This example deals with judicial assessment of *nafaqa* (maintenance or alimony) (fiqhacademy, 2023) and the conditions under which such assessment may be revised. The Arabic verb "يُراجع" presents a potential ambiguity due to the absence of diacritical marks in the source text. When diacritized as "يُراجع" (with a *dammah* on the first letter and a *kasrah* on the fourth), the verb appears in the active voice, meaning “*he revises*”. Conversely, when diacritized as "يُرَاجَع" (with a *dammah* on the first letter and a *fathah* on the fourth), it conveys the passive voice, meaning “*it is revised*” (Almaany, 2024).

In this legal context, the intended meaning aligns with the passive construction—the judgment “*may not be reviewed*” before a year has elapsed—indicating that the action, not the agent, is emphasized.

However, all three neural machine translation tools failed to capture this nuance. Each rendered the verb in the active voice (“the judge shall not review”), thereby misrepresenting the legal intent and shifting agency incorrectly to the judge. This constitutes a semantic and syntactic error, as it alters the grammatical relationship within the clause and affects the interpretation of legal responsibility.

The example highlights a persistent limitation in NMT systems: their difficulty in recognizing voice alternation in non-diacritized Arabic verbs, particularly in formal and legal registers where agency is often implicit. It also underlines the need for deeper syntactic modeling and domain-specific training in order to align MT outputs more closely with the conventions of legal Arabic discourse.

#### Example 06

|             |                                                                                                                                                       |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| Source text | المادة 87: وفي حالة الطلاق، يمنح القاضي/الولاية لمن أسندت له حضانة الأولاد.<br>Literally: In the event of divorce, the judge entrusts the exercise of |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|

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|                     |                                                                                       |                                                                                                                                              |
|---------------------|---------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|
|                     | <i>guardianship</i> to the parent to whom custody of the children has been entrusted. |                                                                                                                                              |
| Machine translation | Google Translate                                                                      | Article 87: In the event of divorce, the judge grants <i>guardianship</i> to the person who has been assigned custody of the children.       |
|                     | Bing Translator                                                                       | Article 87: In the event of divorce, the judge grants <i>guardianship</i> to the person who has been entrusted with custody of the children. |
|                     | Systran Translator                                                                    | Article 87: In the event of divorce, the judge shall grant jurisdiction to the person who has custody of the children.                       |

The example above demonstrates the rule of assigning guardianship of children following divorce, expressed through the Arabic term “الولاية” (Muhammad Ahmad, 2025), which appears in the source text without diacritical marks. This term is semantically complex, as it may convey two distinct meanings depending on its diacritization: when diacritized with a *fathah* above the third and sixth letters (الأولياء), it means “guardianship”; whereas when diacritized with a *kasrah* on the third letter (الولاية), it means “province” or “state” (Almaany, 2024).

Given this ambiguity, the non-diacritized form of “الولاية” can challenge machine translation tools. However, in this instance, the immediate legal and familial context marked by surrounding terms such as *divorce*, *judge*, *custody*, and *children* provides sufficient contextual signals for correct semantic inference.

Both Google and Bing Translators successfully rendered the term as *guardianship*, demonstrating effective contextual disambiguation. By contrast, Systran Translator produced the term *jurisdiction*, which, although related, introduces a semantic deviation that alters the intended legal sense. According to the error classification adopted in this study, this would be categorized as a semantic error, as it modifies the scope of authority implied in the original text.

### Example 07

|             |                                                                                                                                                                                                                                                                                                                                                       |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Source text | <p>المادة (90) : إذا تعارضت مصالح الولي ومصالح القاصر يعين القاضي متصرفا خاصا تلقائيا أو بناء على طلب من له مصلحة.</p> <p>Literally: In the event of a conflict between the interests of the guardian and those of his ward, an ad hoc administrator <i>is appointed</i> ex officio or at the request of a person with an interest, by the judge.</p> |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|                     |                    |                                                                                                                                                                                                                  |
|---------------------|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Machine translation | Google Translate   | Article (90): If the interests of the guardian and the interests of the minor conflict, the judge <i>shall appoint</i> a special administrator automatically or upon the request of the person with an interest. |
|                     | Bing Translator    | Article 90: If the interests of the guardian and the minor's interests' conflict, the judge <i>shall appoint</i> a special administrator automatically or at the request of an interested party.                 |
|                     | Systran Translator | Article 90: If the interests of the guardian and the minor are in conflict, the judge shall automatically <i>appoint</i> a private person or at the request of the person having an interest.                    |

The example above contains the Arabic verb “يُعَيِّن” (yu‘ayyin), which, when undiacritized, can lead to potential ambiguity. In Arabic, the verb “يعين” may convey two distinct meanings depending on its diacritization. When diacritized with a *dammah* above the first letter and a *kasrah* below the third (يُعَيِّن), it means “to assist” or “to help.” Conversely, when diacritized with a *dammah* above the first letter, a *shaddah* on the third letter, and a *kasrah* below it (يُعَيِّن), it means “to appoint” or “to designate.”

In the legal context of this article, the verb clearly denotes appointment, as the sentence refers to the judge’s act of designating a *legal guardian*. Despite the absence of diacritical marks, all three neural machine translation (NMT) tools: Google, Bing, and Systran correctly rendered the term in English as *appoint*. This indicates successful context-based disambiguation, as the systems relied on syntactic and semantic cues rather than orthographic information.

### Example 08

|                     |                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                |
|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Source text         | <p>المادة 144: الأخت الشقيقة بشرط انفرادها، وعدم وجود الشقيق، والأب، وولد <i>الصلب</i>، وولد الابن ذكرا أو أنثى، وعدم الجد الذي يعصبها</p> <p>Literally: Article 144: A full sister, on the condition that she is alone, and that there is no full brother, father, a biological son, or a male or female grandson, and the absence of a grandfather who allows her to inherit through agnation</p> |                                                                                                                                                                                                |
| Machine translation | Google Translate                                                                                                                                                                                                                                                                                                                                                                                    | Article 144: A full sister, provided that she is alone, and there is no brother, father, <i>biological child</i> , son’s child, male or female, and there is no grandfather who is her agnate. |
|                     | Bing Translator                                                                                                                                                                                                                                                                                                                                                                                     | Article 144: The sister provided that she is alone, and there is no brother, father, <i>crucifixion</i> , <i>son</i> male or female, and not grandfather who incapacitates her                 |

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|  |                    |                                                                                                                                                                                                   |
|--|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | Systran Translator | Article 144: a sister on condition of her own, the absence of a brother, the father, <i>the son of a steel</i> , the son of a male or female, and the lack of a grandfather who makes her nervous |
|--|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

The example above enumerates the categories of heirs entitled to inheritance shares, among whom is the biological son, referred to in Arabic as “ولد الصلب” (walad al-ṣulb); a compound term consisting of “ولد” (child) and “الصلب” (backbone). (Surah Qur’an, 2024). However, the second element of the compound, “الصلب”, may give rise to ambiguity when undiacritized. Depending on its diacritization, the word may bear different meanings:

- With a dammah above the first letter (صُلْب), it denotes *backbone* or *biological descent*;
- With a fathah above the first letter (صَلْب), it can mean *steel*;
- With the same fathah, in another semantic context, it may also mean *crucifixion*.

In the absence of diacritical marks, only Google Translate was able to correctly infer the intended meaning — *biological son* — by relying on contextual and collocational cues. Both Bing and Systran failed to interpret the compound accurately, producing the nonsensical renderings “*crucifixion son*” and “*son of steel*”, respectively. These mistranslations constitute severe semantic errors, as they distort the legal sense of the article and compromise its interpretative validity.

This example clearly demonstrates how contextual inference plays a decisive role in machine translation of undiacritized Arabic legal texts. While Google’s model succeeded in resolving the lexical ambiguity through contextual analysis, Bing and Systran exhibited limitations in handling compound expressions embedded in specialized religious-legal discourse, where literal or dictionary-based approaches result in domain-inappropriate outputs.

### Example 09

|                     |                                                                                                              |                                                                        |
|---------------------|--------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------|
| Source text         | المادة 200: تصح الوصية مع اختلاف الدين.<br>Literally: The will shall be valid even with different religions. |                                                                        |
| Machine translation | Google Translate                                                                                             | Article 200: A will is valid even if the <i>religion</i> is different. |
|                     | Bing Translator                                                                                              | Article 200: A will is valid with a difference of <i>religion</i> .    |
|                     | Systran Translator                                                                                           | Article 200: The will is valid with different <i>religions</i> .       |

The example above states that a will remains legally valid even when the religion of the testator and that of the inheritors differ, employing the Arabic term “الدين” (ad-din) to denote *religion*. This word, however, is polysemous and may yield different meanings depending on its diacritical configuration. When diacritized with a kasrah below the third letter and a shaddah above it (الدِّين), it signifies *religion* or *faith*; whereas when diacritized with a fathah and a shaddah above the third letter (الدَّيْن), it denotes *debt* or *financial obligation* (Almaany, 2024).

Given the absence of diacritical marks in the Algerian Family Code, such ambiguity could potentially challenge machine translation systems. However, in this instance, all three neural machine translation tools — Google, Bing, and Systran — successfully identified the intended sense of *religion* by relying on contextual inference. The surrounding lexical environment, particularly the co-occurrence of *will* (الوصية) and *religion* (الدين), provided sufficient semantic cues for accurate disambiguation.

This case illustrates how context-dependent reasoning enables neural translation systems to resolve lexical ambiguity effectively, especially when the term in question appears within legal or religious discourse where certain collocations (e.g., *will* + *religion*) are strongly constrained semantically. It also demonstrates that, for semantically transparent legal formulations, all three systems are capable of reaching comparable performance despite the lack of diacritics.

#### Example 10

|                     |                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                               |
|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Source text         | <p>المادة 32: يفسخ النكاح إذا اختل أحد أركانه، أو اشتمل على مانع أو شرط يتنافى ومقتضيات العقد أو ثبتت ردة الزوج.</p> <p>Literally: Marriage shall be annulled if one of its pillars is vitiated, or if it includes an impediment or a condition inconsistent with the requirements of the contract, or the <i>apostasy</i> of the husband has been approved.</p> |                                                                                                                                                                                                                                               |
| Machine translation | Google Translate                                                                                                                                                                                                                                                                                                                                                 | Article 32: The marriage contract shall be annulled if one of its pillars is missing, or if it includes an impediment or condition that is inconsistent with the requirements of the contract, or if the <i>husband's apostasy</i> is proven. |
|                     | Bing Translator                                                                                                                                                                                                                                                                                                                                                  | Article 32: The marriage shall be annulled if one of its elements is disturbed, or if it contains an impediment or condition that contradicts the requirements of the contract or if the <i>husband's apostasy</i> is proved.                 |
|                     | Systran Translator                                                                                                                                                                                                                                                                                                                                               | Article 32: The marriage shall be annulled if one of the pillars of the marriage fails, or if it includes an impediment or condition that contravenes the requirements of the contract or proves <i>the spouse's return</i> .                 |

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The example above outlines the circumstances under which a marriage may be annulled, among which is the husband's apostasy, defined as renouncing or abandoning the Islamic faith (Alalwani, 2011). The Arabic term “ردة” (riddah) is presented in the source text without diacritical marks, creating potential ambiguity for machine translation systems. When diacritized with a kasrah below the first letter (رِدة), the term signifies *apostasy*; however, when diacritized with a fathah above the first letter (رَدة), it conveys the meaning of *return* or *turning back* (Almaany, 2024).

In this context, the semantic environment surrounding “ردة الزوج” (“the husband's riddah”) clearly points to the religious-legal notion of apostasy. Google Translate and Bing Translator both successfully identified this contextual meaning and rendered the term accurately as *apostasy*, despite the absence of diacritics. Systran Translator, however, failed to infer the intended sense and produced the erroneous equivalent *return*, which led to a semantic distortion that undermines the legal meaning of the provision.

This case illustrates that while neural systems generally demonstrate contextual inference ability, they remain vulnerable to lexical ambiguity in legal-religious discourse, particularly when terms derive their precise meaning from diacritical variation. The results here highlight both the promise and limitations of neural machine translation in handling non-diacritized Arabic legal terminology.

**Table N°1:** number of errors of each machine translation tool and the rate error in total

| Examples | Google translate |      | Bing translator  |      | Systran Translator |      |
|----------|------------------|------|------------------|------|--------------------|------|
| 10       | Number of errors | Rate | Number of errors | Rate | Number of errors   | Rate |
|          | 2                | 20 % | 3                | 30 % | 5                  | 50 % |

## 8. Discussion

The results of this study indicate that neural-based machine translation tools performed reasonably well in rendering Arabic legal terminology. In several instances, the three systems—Google Translate, Bing Translator, and Systran Translator—were able to infer the correct meaning of ambiguous Arabic words even though the source texts lacked diacritical marks. The passages were deliberately selected for their lexical ambiguity, as each contained a term whose interpretation varies depending on the diacritics placed above or below its letters.

Despite this shared ability to rely on contextual inference, the overall accuracy of the three systems differed considerably. Google Translate produced the most accurate results, with an error rate of around 20%, successfully translating 80% of the test samples. This level of accuracy is noteworthy given the complexity of Arabic morphology and the highly

specialized nature of legal discourse. Bing Translator followed with an error rate of 30%, while Systran Translator recorded the lowest performance with 40% of its outputs containing errors.

A qualitative analysis of the errors shows that most were semantic or cultural in nature. Semantic errors occurred when the systems misinterpreted the contextual meaning of words with multiple possible readings, such as *يراجع* (“to be reviewed” vs. “to review”) or *ردة* (“apostasy” vs. “return”). These cases reveal that some models still struggle with recognizing grammatical voice and contextual cues in morphologically rich languages like Arabic. Cultural errors, on the other hand, appeared in the translation of expressions that are closely tied to Islamic or Arabic legal traditions. For example, Bing and Systran mistranslated *ولد الصلب*—a fixed expression meaning “biological son”—as “crucifixion son” and “son of steel,” respectively. Google, however, correctly inferred the intended sense from context.

The difference in performance among the three neural machine translation systems can largely be attributed to their neural architecture, attention mechanisms, and exposure to multilingual corpora.

## 9. Conclusion

In conclusion, this study has shown that machine translation has undergone significant advancements with the introduction of neural approaches powered by artificial intelligence, which have substantially improved translation quality across diverse language pairs. Nevertheless, certain languages, such as Arabic, pose unique challenges due to linguistic features that are not shared by many others—most notably the use of diacritics to determine word meaning. While native speakers can typically rely on context to infer the intended sense of non-diacritized words, machine translation systems must depend entirely on contextual inference to achieve the same result.

The analysis demonstrated how the absence of diacritics can impact the accuracy of neural machine translation (NMT) when rendering Arabic legal texts. The findings revealed that performance varied among the three systems tested: Google Translate achieved an accuracy rate of approximately 80%, followed by Bing Translator with 70%, and Systran Translator with 60%. These results are generally consistent with previous research, confirming that recent NMT architectures can handle semantic ambiguity more effectively than earlier statistical or rule-based systems.

Furthermore, the study indicates that NMT models disambiguate meaning primarily through attention mechanisms, which allow them to evaluate contextual relationships across entire sentences rather than processing words in isolation. This capacity enables neural systems, particularly those trained on extensive multilingual corpora such as Google Translate, to infer the correct meaning of non-diacritized legal terms with a high degree of accuracy. However, the variation in performance across systems underscores the continuing importance of training data quality, domain adaptation, and architectural refinement in improving the handling of context-dependent linguistic phenomena in Arabic legal translation.

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