Hieroglyphics To English Translation

1. **Deep Learning Meets Egyptology: A Hieroglyphic Transformer for Translating Ancient Egyptian (2024)**

This paper introduces a Hieroglyphic Transformer model, built on **the M2M-100** multilingual translation framework, to automate the translation of ancient Egyptian hieroglyphs into German and English. The main goal is to bridge the gap between Egyptology and Natural Language Processing (NLP) by leveraging a curated dataset from **the *Thesaurus Linguae Aegyptiae* (TLA)** database. The methodology involves data extraction, cleaning, and pairing hieroglyphs with translations, then fine-tuning the M2M-100 model using transfer learning. The model is evaluated using automated metrics **(SacreBLEU, ROUGE-L)** and **human assessment.** The primary challenge is the scarcity of machine-readable data for ancient Egyptians, particularly for English translations, which limits the model's training and performance. Despite this, the model shows promising results, especially when incorporating back-translation and transliteration data.

GitHub: https://github.com/mattia-decao/hiero-transformer

Dataset: Thesaurus Linguae Aegyptiae

2. **An AI-Based Automatic Translator for Ancient Hieroglyphic Language—From Scanned Images to English Text (2023)**

This paper proposes an **AI-based framework** to automatically translate ancient Egyptian hieroglyphs from scanned images into English text, aiming to enhance the experience of tourists visiting historical sites. The methodology involves two main tasks: **glyph detection and recognition** using image processing techniques (e.g., R-CNN, ResNet50, and Siamese networks) and **hieroglyph-to-English translation** using Natural Language Processing (NLP) techniques, including segmentation, mapping, and machine translation with Transformer models. The primary challenge is the **low-resource nature of hieroglyphic language**, which includes limited datasets, unbalanced glyph distributions, and the complexity of the language's structure (e.g., lack of spaces between words and the presence of determinatives).

Datasets:

- Fayrose/Lauren Fay Dataset
- Morris Franken Dataset
- Hugging Face Dataset
- Ancient Egypt Dictionary

3. Multi-Task Modeling of Phonographic Languages: Translating Middle Egyptian Hieroglyphs (2019)

This paper addresses the **low-resource problem** in translating **Middle Egyptian hieroglyphs** by proposing a **multi-task learning approach** inspired by speech translation techniques. The main idea is to leverage the phonographic nature of hieroglyphs and share structural information between tasks like hieroglyph transcription, translation, and POS tagging to improve direct translation without requiring manual transcription at test time. The methodology involves using a **neural sequence-to-sequence model** with attention mechanisms, trained on a dataset from the **Thesaurus Linguae Aegyptiae (TLA)**, and incorporating multi-task learning to improve translation performance. The key challenge is the **limited availability of parallel hieroglyphic data** and the complexity of the hieroglyphic writing system, which includes phonograms, ideograms, and determinatives. The study focuses on translating hieroglyphs into **German**, as the TLA dataset primarily provides German translations. Despite these challenges, the approach achieves a **3 BLEU point improvement** over baseline models, demonstrating the effectiveness of multi-task learning in low-resource scenarios. While the paper does not target English translation, the methodology could be adapted for English or other languages if suitable parallel datasets were available.

Dataset: Thesaurus Linguae Aegyptiae

4. **Hieroglyphs Language Translator using deep learning techniques (Scriba) (2022)**

Needs IEEE Access

Egyptian hieroglyphs are symbols that are part of the ancient Egyptian writing system. Hieroglyphs do not have a fixed writing direction, and a single glyph can have multiple definitions, making them difficult to translate into spoken language. Deep learning techniques, such as EfficientNet, MobileNet, and ShuffleNet, have been tested on two hieroglyph datasets (with and without data augmentation). Current experiments revealed that MobileNet and EfficientNet produced the most accurate results Ranging from 99% to 100%. Scriba is a flutter-based mobile application that shall use one of the mentioned algorithms to provide a precise translation of hieroglyphs. This paper thoroughly discusses the proposed development approach, experiments that were carried out (and their results), and the implementation of the mobile application.

5. **LogogramNLP: Comparing Visual and Textual Representations (2024)**

The main idea of the paper is to explore the effectiveness of using visual representations, rather than traditional symbolic text, for natural language processing (NLP) tasks on ancient logographic writing systems. The authors introduce **LogogramNLP**, a benchmark that includes both transcribed and visual datasets for four ancient logographic languages (Linear A, Egyptian hieroglyphic, Cuneiform, and Bamboo Script), and evaluate various NLP tasks such as classification, translation, and parsing. The methodology involves comparing visual and textual encoding strategies, leveraging pre-trained models like PIXEL and BERT, and fine-tuning them on benchmark tasks. The primary problem faced is the scarcity of transcribed data for ancient logographic languages, as much of the available data exists only in visual form (e.g., photographs or hand-drawn copies), making traditional NLP pipelines, which rely on symbolic text, difficult to apply. Additionally, the lack of Unicode mappings and inconsistent transliteration standards further complicate the processing of these languages.

GitHub: https://github.com/taineleau/logogramnlp **The code has not been uploaded yet.**

Dataset: https://github.com/taineleau/logogramNLP/tree/main/data **The Dataset has not been uploaded yet.**

6. **When Hieroglyphs Meet Technology: A Linguistic Journey through Ancient Egypt Using Natural Language Processing (2024)**

The main idea of the paper is to explore how **Natural Language Processing (NLP)** techniques can be applied to study the various stages of the **Ancient Egyptian language**, including Old, Middle, and Late Egyptian, as well as **Demotic** and **Coptic**. The paper provides a comprehensive survey of existing NLP research on these languages, focusing on tasks such as **transliteration**, **translation**, **text classification**, and **morphological analysis**. The methodology involves reviewing and analyzing previous studies, datasets, and tools developed for these languages, particularly highlighting the challenges of working with **low-resource** and **ancient languages**. The primary problem faced is the **lack of annotated corpora**, the **fragmented nature of the texts**, and the **absence of native speakers**, which makes tasks like transliteration and translation particularly difficult. While the paper discusses translation efforts, it primarily focuses on **transliteration** and **segmentation** rather than direct translation into English. The paper aims to encourage more research in this area by highlighting the potential of NLP to unlock insights into ancient cultures and languages.

- **Datasets:**
- St. Andrews Corpus (Middle Egyptian)
- Ramses Project (Late Egyptian)
- Chicago Demotic Dictionary (CDD)
- Coptic Scriptorium (1)
- Coptic Scriptorium (2)
- Database and Dictionary of Greek Loanwords in Coptic
- Marcion Project
- Thesaurus Linguae Aegyptiae
- Thot Sign List (TSL) **(Needs Account)**

7. **Automatic Egyptian hieroglyph recognition by retrieving images as texts (2013)**

Needs Access

In this paper we propose an approach for automatically recognizing ancient Egyptian hieroglyph from photographs. To this end we first manually annotated and segmented a large

collection of nearly 4,000 hieroglyphs. In our automatic approach we localize and segment each individual hieroglyph, determine the reading order and subsequently evaluate 5 visual descriptors in 3 different matching schemes to evaluate visual hieroglyph recognition. In addition to visual-only cues, we use a corpus of Egyptian texts to learn language models that help re-rank the visual output.

8. Extending Gardiner's code for Hieroglyphic recognition and English mapping (2020)

"Knowledge is power" … Writing is the main way to preserve the humanity knowledge across the ages. Therefore, an automatic and accurate mapping from ancient scripts to modern live language is a must to have. Such a system will support knowledge transfer, tourism and education. This article presents a new algorithm to segment and recognize the ancient Egyptian Hieroglyphs from images and produce the corresponding English meaning. The algorithm used image processing along with Optical Character Recognition (OCR). Then, the meaning behind the image containing Hieroglyphs is interpreted based on the context of the mapped English sentence. Gardiner's sign list is a standard list used to classify the Hieroglyphics symbols such that similar shapes are grouped in the same category. Hence, Hieroglyphics script is mapped to the English language. Hieroglyphics could be either read from left to right or from right to left based on the face orientation of the Hieroglyphic symbol. However, Gardiner's code does not help to automate the reading direction of the Hieroglyphics script. In this work, an extension of the list is proposed to resolve the ambiguity in the reading direction. The results of the segmentation and recognition of Hieroglyphics symbols are demonstrated and compared to similar work for Chinese character recognition. Moreover, the results obtained from the state-ofthe-art used in Hieroglyphic character recognition compared to the results obtained from the proposed algorithm on Hieroglyphic character are addressed. The mapped English sentence is then compared to some defined patterns. When a match is found, the input gets structured and reformatted accordingly. Tests on the defined patterns were conducted, and the results were successful, however, some additional results are generated that show equivalent synonyms to the input English sentence.

Dataset: Data is available upon request

Code: Upon request

9. Recognition of Egyptian hieroglyphic texts through focused generic segmentation and cross-validation voting (2025)

Ancient Egyptian hieroglyphs form part of a complex language that has attracted the attention of Egyptologists, historians, and amateurs for centuries. In use for more than 3000 years, they consist of hundreds of symbols that can be transcribed into their Latin phonemes. Although there have been some previous works on the recognition of hieroglyphs through computer vision, this is a study of unprecedented depths and presents several unique contributions. On the one hand, we have created the largest and most complete dataset of existing Egyptian hieroglyphs to date, covering all the main symbols used on stelae. On the other, we have carried out a systematic analysis of detection, segmentation, and classification methods, focusing our research on a composite method of focused generic segmentation and classification with an ensemble model of ConvNeXt backbones using Cross-Validation Voting (CVV). Our trained model has been evaluated against several carved or painted stone stelae, obtaining excellent results. To the best of our knowledge, there is currently no other methodology capable of obtaining the classification results presented in this paper, and the method and the dataset presented represent a very significant advancement in the development of automated methods for reading Egyptian hieroglyphic texts.

GitHub: rfuentesfe/EgyptianHieroglyphicText (Without Code)

Dataset: https://github.com/rfuentesfe/EgyptianHieroglyphicText/tree/main/dataset

10. A Deep Learning Approach to Ancient Egyptian Hieroglyphs Classification (2021)

ABSTRACT Nowadays, advances in Artificial Intelligence (AI), especially in machine and deep learning, present new opportunities to build tools that support the work of specialists in areas apparently far from the information technology field. One example of such areas is that of ancient Egyptian hieroglyphic writing. In this study, we explore the ability of different convolutional neural networks (CNNs) to classify pictures of ancient Egyptian hieroglyphs coming from two different datasets of images. Three well-known CNN architectures (ResNet-50, Inception-v3 and Xception) were taken into consideration and trained on the available images. The paradigm of transfer learning was tested as well. In addition, modifying the architecture of one of the previous networks, we developed a specifically dedicated CNN, named Glyphnet, tailoring its complexity to our classification task. Performance comparison tests were carried out and Glyphnet showed the best performances with

respect to the other CNNs. In conclusion, this work shows how the ancient Egyptian hieroglyphs identification task can be supported by the deep learning paradigm, laying the foundation for information tools supporting automatic document recognition, classification and, most importantly, the language translation task.

GitHub:https://github.com/dqj5182/egyptian_hieroglyph_classification_convnet/tree/main

Dataset: Not provided

11. Egyptian Hieroglyphs Segmentation with Convolutional Neural Networks (2023)

The objective of this work is to show the application of a Deep Learning algorithm able to operate the segmentation of ancient Egyptian hieroglyphs present in an image, with the ambition to be as versatile as possible despite the variability of the image source. The problem is quite complex, the main obstacles being the considerable amount of different classes of existing hieroglyphs, the differences related to the hand of the scribe as well as the great differences among the various supports, such as papyri, stone or wood, where they are written. Furthermore, as in all archaeological f inds, damage to the supports are frequent, with the consequence that hieroglyphs can be partially corrupted. In order to face this challenging problem, we leverage on the well-known Detectron2 platform, developed by the Facebook AI Research Group, focusing on the Mask R-CNN architecture to perform segmentation of image instances. Likewise, for several machine learning studies, one of the hardest challenges is the creation of a suitable dataset. In this paper, we will describe a hieroglyph dataset that has been created for the purpose of segmentation, highlighting its pros and cons, and the impact of different hyperparameters on the final results. Tests on the segmentation of images taken from public databases will also be presented and discussed along with the limitations of our study.

Datasets:

- Images
- for data from the Pyramid of Unas

12. AN AI BASED AUTOMATIC TRANSLATOR FOR ANCIENT HEIROGLYPHIC LANGUAGE- FROM SCANNED IMAGES TO ENGLISH TEXT (2024)

This paper proposes a novel approach for translating Hieroglyphic images into text using Natural Language Processing(NLP) techniques and the VGG-16 Convolutional Neural Network(CNN) architecture. Hieroglyphs pose a unique challenge due to their complex visual representation and diverse meaning, requiring advanced computational methods for accurate interpretation. Although there are a lot of automatic translators available these days, there hasn't been much progress made in the hieroglyphic language, an ancient Egyptian language which is a low resource language. Therefore, in order to address the issue of translating hieroglyphic language, we are putting forth a novel framework. This could be the next revolutionary advancement in artificial intelligence, utilizing deep learning algorithms and natural language processing techniques. The first step involves pre-processing the hieroglyphic images to enhance clarity and remove noise, preparing them for feature extraction. The VGG-16 CNN is then employed to extract high-level features from the pre-processed images, capturing intricate details crucial for deciphering hieroglyphic symbols. Next, a hybrid NLP model is utilized to process the extracted features and generate textual representations of the hieroglyphs. This model combines deep learning techniques with linguistic rules and contextual analysis to accurately translate visual hieroglyphs into meaningful text. The experimental results demonstrate promising accuracy rates in hieroglyphic image translation, showcasing the potential of integrating NLP and deep learning methodologies for deciphering ancient scripts. This research contributes to the field of digital archaeology and cultural preservation by providing an automated tool for interpreting and understanding hieroglyphic inscriptions. This work's fundamental goal is to improve visitors' experiences at authentic Egyptian sites while also assisting with research and development.

Dataset: A dataset is a collection of data treated as a single unit by a computer. It contains separate pieces of data but can be used to train an algorithm with the goal of finding predictable patterns within the entire dataset. High-quality datasets are essential for AI advances, often more critical than the algorithms themselves. In fact, having high-quality datasets can lead to breakthroughs in AI six times faster than improvements in algorithms

13. Image Based Hieroglyphic Character Recognition (2018)

Needs IEEE Access

Image Based Hieroglyphic Character Recognition was thought of to enable anyone interested in knowing the meaning of the hieroglyphs to use an algorithm to recognize the hieroglyphs to a well-known language. Since English is the most frequently used language in scientific work, therefore, the hieroglyphs will be translated to English language. The algorithm used is mainly about Optical Character Recognition (OCR) in the image processing field. The algorithm works as follows: An image that contains the hieroglyphs to be translated is taken as an input. Consequently, segmentation of the image will occur to cut every hieroglyph into a separate image, then, post-processing will be done to get only the region of interest in the image so that every image will be taken and compared to images in the data set to find the best match of the image using matching techniques. There were plenty of matching techniques tested until reaching Histogram of Oriented Gradients (HOG) that gave the best results in terms of accuracy. Then, the image will be translated to English language and displayed for the user in a text file. This paper addresses the contribution which is mainly controlling of the segmentation order for correct reading order by means of linkage to Gardiner's code and matching which is extremely essential to have correct results in recognition.

14. Automatic Egyptian Hieroglyph Recognition by Retrieving Images as Texts

In this paper we propose an approach for automatically recognizing ancient Egyptian hieroglyph from photographs. To this end we first manually annotated and segmented a large collection of nearly 4,000 hieroglyphs. In our automatic approach we localize and segment each individual hieroglyph, determine the reading order and subsequently evaluate 5 visual descriptors in 3 different matching schemes to evaluate visual hieroglyph recognition. In addition to visual-only cues, we use a corpus of Egyptian texts to learn language models that help re-rank the visual output.

Dataset:

Text Corpus

Visual Dataset: The photographs are from the pyramid of Unas, and the dataset was manually annotated by the authors. (Not Provided).

15. **Deciphering the Ancient Script: A Novel Approach to Hieroglyphic Language Translation**

Unveiling the Secrets of the Ancients: Advanced AI Techniques for Hieroglyphic Interpretation" proposes a groundbreaking framework employing the latest innovations in Artificial Intelligence, particularly in Machine Learning and Deep Learning domains, to redefine the methodology of translating ancient Egyptian Hieroglyphic texts into English. This endeavor aims to revolutionize the visitor experience at historical Egyptian sites by introducing an application capable of translating hieroglyphic inscriptions captured in images directly into comprehensible English. By leveraging sophisticated Image Processing, Natural Language Processing (NLP), and AI methodologies, this system promises to facilitate the automatic detection, recognition, and translation of hieroglyphic symbols.

GitHub contains most of the research papers related to our problem.