Cryptanalysis and Language Deciphering: A 'Brute Force Attack' on an Undeciphered Writing System

> Loh Jia Sheng Colin Dr Perono Cacciafoco, Francesco



- Background on Linear A as an Ancient Writing System
- **Python** as a powerful programming language
- Overview of the Linear A decipherment Python program
- Visual representation of how the Python program works
- References and acknowledgement

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Introduction



Linear A

Linear A is one of the writing systems of the Ancient Aegean Minoan civilization of Crete, dating back to the Bronze Age. Despite many past attempts by scholars, glyph-breakers and linguists, Linear A continues to remain undeciphered due to its elusive underlying language

Background

Linear A has around 90 signs/ symbols in regular use, where a large majority of them are considered distinct when compared to Linear B.

Source

Linear A symbols and inscriptions are found on a variety of artefacts which includes roundels, tablets and seals that indicate economic transactions.

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Linear A tablets

Linear A tablet ARKH 2 (Arkhanes)



digitally enhanced

Linear A tablet KH 5 (Khania)



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Linear B syllabary



Figure: Linear B syllabary, deciphered by Michael Ventris in 1952

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Attempts to decipher Linear A

Many attempted to decipher Linear A by assigning Linear B phonetic values to Linear A signs that appear graphically similar.

Flaws in past decipherments

Linear B encodes Mycenaean Greek whereas Linear A encodes Aegean Minoan. There is a disproportionate time difference between the use of each writing system.Furthermore, close to 80% of Linear A symbols are unique to that of Linear B.

Recent studies

Recent studies on the decipherment on Linear A has proposed that Linear A could have relations with other languages such as Luwian and various language families such as the Semitic language family, Indo-European language family and even the Afro-Asiatic language family.

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Programming

With the computational power of programming, we aim to develop a software that is able to isolate significant clusters of Linear A symbols while attempt to reconstruct the Minoan phonetics.

Python



- Python is one of the most popular programming language.
- Python can serve as cross-compliers to other programming languages such as Javascript, while having various implementations.
- Data analytics using Python module 'pandas'
- Creation of computer graphical user interface (GUI) using Python module 'PyQt'
- Web application design using Python module 'Flask

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Python modules

Our research team has adopted 'pandas' and 'PyQt' to be the two main Python modules used for our Python program.

Python program

To start off, the Python program can be segmented into 'Specific Decipherment' and 'General Decipherment'.

Incorporate the comparison of numerous language dictionaries with our Linear A master list, comprised of GORILA 1 - 5.

Basis of Comparison

Basis of comparison would be identical matches between Linear A words, and the words in the dictionaries, after having the vowels removed.

Results

Results will be displayed in a clear table format with four columns.

- 'Identical Matches' Strings with a one-to-one character match
- 'Linear A word' Original Linear A word, without any modifications.
- 'Source' Tablet source which the original Linear A word can be found.
- 'Dictionary Word' the original word from the dictionary of interest.

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Specific Decipherment - Visual



Specific Decipherment Front Page

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Analysis

Analysis of the 'triplets' present in Linear A words is also included. For symbols in Linear A that do not appear graphically similar to any of the symbols present in the Linear B syllabary, these symbols would be represented as numbers in the form of a 'triplet'.

Overview

- A 'triplet' is able to take on any possible character ranging from A-Z.
- Comparison with the words in the other dictionaries is conducted.
- Frequency of which a character replacing the 'triplet' would have identical matches is further analysed.

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Specific Decipherment - Visual 2

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2	056	0	0	0	0	
3	021	0	1	0	0	
4	301	0	0	0	0	
5	029	0	0	0	0	
6	188	0	0	0	1	
7	076	0	2	0	0	
8	305	0	1	0	0	
9	312	0	2	0	0	
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Figure: 'Triplets' Analysis

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General Decipherment Visual

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Figure: Requirements for Upload file

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General Decipherment Visual



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General Decipherment After Upload

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General Decipherment 2 is a function developed to allow user to make dynamic changes in their comparisons. Through this function, users are able to make comparisons based on their two files of choice, namely "Base Sheet" and "Comparison Sheet".

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Similar to the earlier function, this function would output the results in a table format comprised of four columns, and users are able to download the results in a CSV file.

Addition Benefit

This allow users to have higher degree of freedom and enables more efficient research work as changes to both their "Comparison Sheet" and master list dynamically.

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General Decipherment 2 Visual

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General Decipherment 2 Visual

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lons	KU-NI-SU	kanes	HT956		
kers	KI-RA-SI	kursa	ТУЗЬ		
kw	KU+WA	kuwa	HT38		
mm	MA+MA	mema	PHBa		
mn]-MI-NA-[man	KH 79 + 89		
mz	MA-ZA	maz	ZA010b		
mz	MA-ZU	maz	HT102		
mz	ME-ZA	maz	HTIDA		
nt	NA-TI	nata	HT97a		
nt	NA-TU	nata	HT47a		
nt	NI-TA-	nata	ARKI004a		
nt	NU-TE	nata	HT154Ja		
nt	NU-TI	nata	Z4009		
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General Decipherment 2 After Uploads

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Desktop Icon



Figure: Desktop Icon

Ergonomics

The program has been designed to be an executable GUI file in the computer using the 'PyQt' module.

Benefits

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Figure: Desktop Icon

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Benefits

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Coding to Decipher Linear A Perono Cacciafoco, Francesco; DuoDuo, Xu; Niki Cassandra Min, Eu

Minoan Linguistic Resources: The Linear A Digital Corpus Petrolito, Tommaso et al

https://linearbknossosmycenae.com/

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