Lessons of the Past, Tools of the Future

A Computational Decipherment of Linear B

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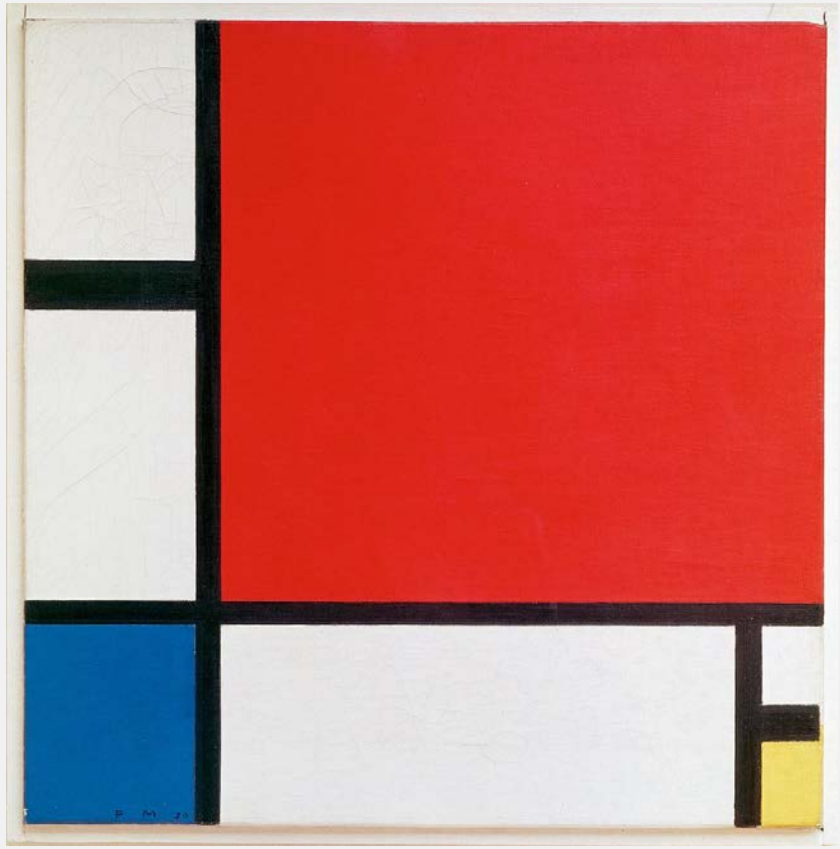
Creativity is Limitation



Composition with Red Blue and Yellow, Piet Mondrian 1930

- Limitation: Follow the steps of the original decipherment
  - “Standing on the Shoulders of Giants”
- A different approach to a interdisciplinary project

Background

- Linear B was found on Crete and at select places on the mainland
- It is a syllabic language
- The language was used administratively
- Related languages
  - Linear A, Cypro-Minoan, Cretan Hieroglyphs, Classical Cypriot

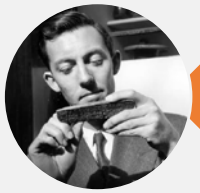
A Recipe for Decipherment

1) Correctly classify and transcribe tablets

Completed by Emmett L. Bennett Jr.

2) Find evidence of inflection

Completed by Alice Kober



3) Create a grid of characters

Completed by Michael Ventris

4) Begin assigning likely values to the grid

Completed by John Chadwick & Ventris

	A	E	I	O	U
VOWEL					
D					
J					
K					
M					
N					
P					
Q					
R					
S					
T					
W					
Z					

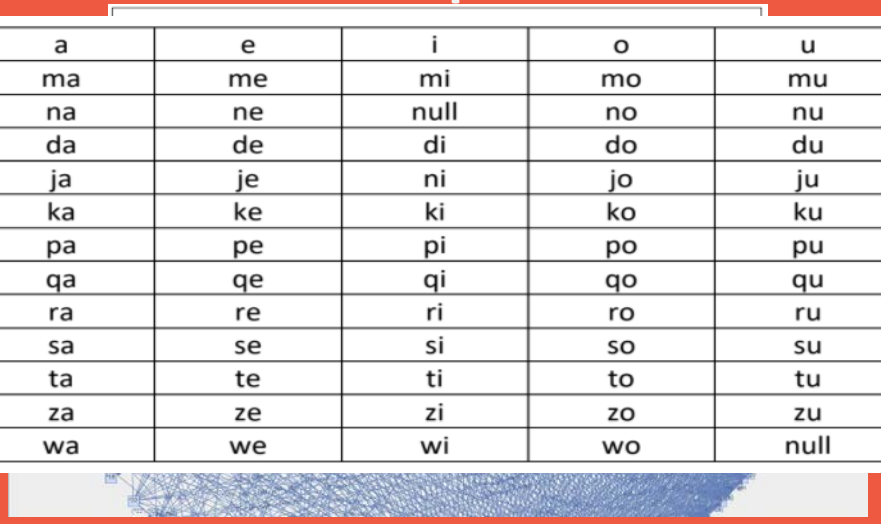
System flow

Every tablet → Find inflection → A graph showing shared vowels/ consonants → Final grid of values

Output

```
identifier;location;series;inscript
KN Ag 87;KN;Ag;]-wa , ;]-wa VIR 1 M
KN Ag 88 + 7033;KN;Ag;pe-re-ko , ;p
KN Ag 89;KN;Ag;to-ro-wo , ;]to-ro-w
KN Ag 90;KN;Ag;e-ri-*19 , ;e-ri-*19
KN Ag 91;KN;Ag;ke-re-u , ;ke-re-u V
KN Ag 1654;KN;Ag;qe-ri-jo , ;qe-ri-
KN Ai 338;KN;Ai;]-ja , ;.A ] ko-wa
KN Ai 632;KN;Ai;]-ta-ra2 , ;]-ta-ra
KN Ai 752 + 753;KN;Ai;re-ja , ;]re-
KN Ai 762;KN;Ai;e-ne-ra , ;]ra-ma-n
KN Ai 824;KN;Ai;do-e-ra , ;a-pi-qo-
KN Ak 611;KN;Ak;to-te-ja , (de)-di-
```

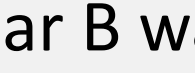
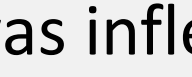
a	e	i	o	u
ma	me	mi	mo	mu
na	ne	null	no	nu
da	de	di	do	du
ja	je	ni	jo	ju
ka	ke	ki	ko	ku
pa	pe	pi	po	pu
qa	qe	qi	qo	qu
ra	re	ri	ro	ru
sa	se	si	so	su
ta	te	ti	to	tu
za	ze	zi	zo	zu
wa	we	wi	wo	null

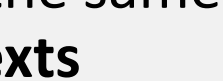


```
firmed with Chadwick & Ventris 1973
] ko-wo , me-wi-jo (1)[ vacat [
```

Finding Inflection

- Kober originally found evidence that Linear B was inflected
- Kober's algorithm
  - Select **words which are followed by ideograms and numerals**
  - Find the same **word in different contexts**
  - Find **predictable patterns** where the word endings change

	Type A		Type B		
Case I					
Case II					
Case III					

	Type C	Type D	Type E
Case I			
Case II			
Case III			

Inflection Algorithm

- A visual representation
- Loop through each word
  - Loop through each word
    - If the word is exactly the same – ignore
    - Else
      - Loop through the characters in word 1
        - Does this character match the character in word 2
          - Increase the similarity
        - Else – stop, these words are dissimilar

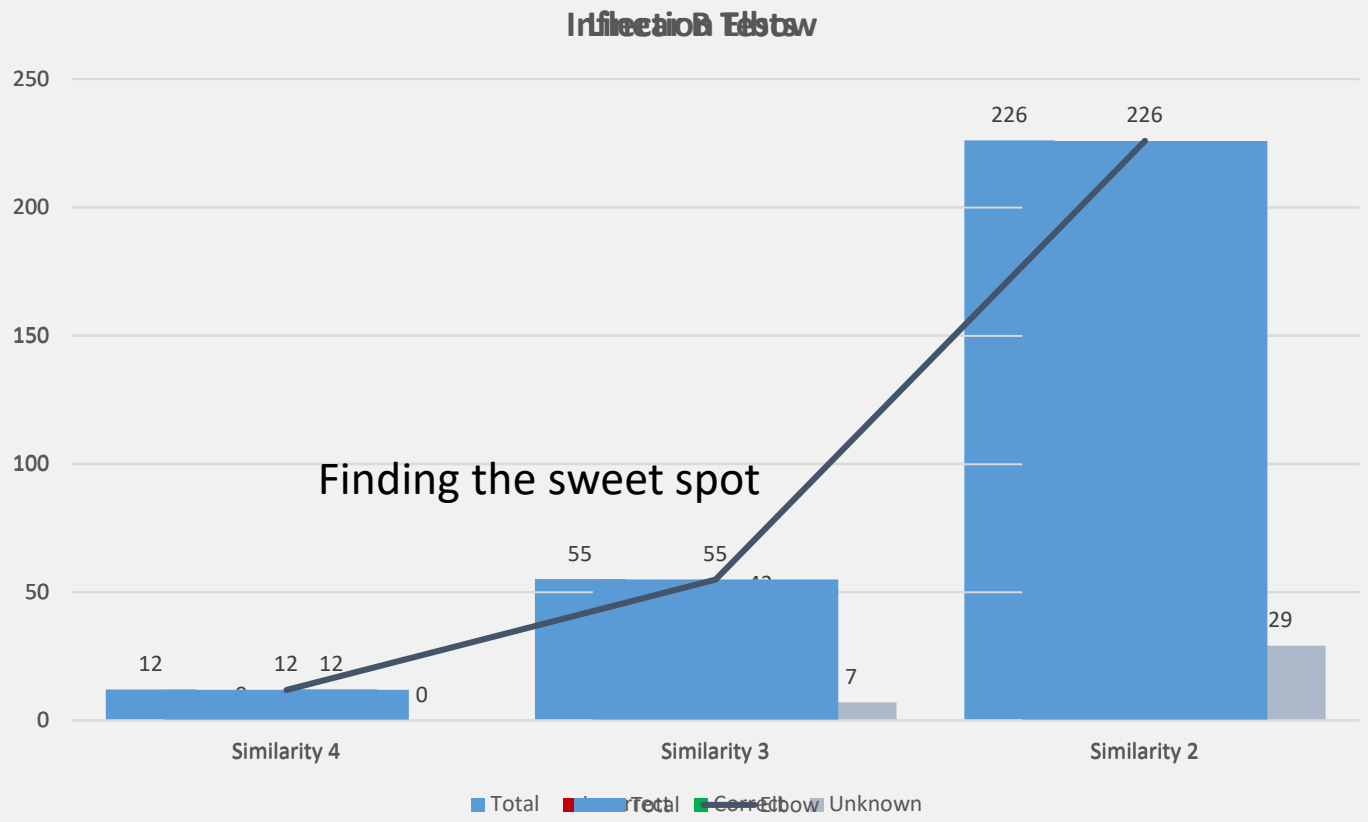
walk	[w,a,l,k]
talking	[t,a,l,k,i,n,g]
walking →	[w,a,l,k,i,n,g]
wanting	[w,a,n,t,i,n,g]
walked	[w,a,l,k,e,d]

Loop	Word 1	Word 2	Similarity
1 →	walk	walk	0
2	walk	talking	0
3 →	walk	walking	4
4	walk	wanting	2

Loop	walk	wanting	Similarity
1 →	w	w	1
2 →	a	a	2
3	l	n	2

Inflection Results

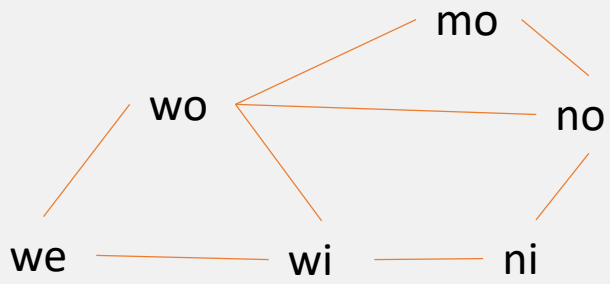
```
po-ti-ni-ja Confirmed? true
 -po-ti-ni-ja-we-jo
 -po-ti-ni-ja-we
 -po-ti-ni-ja-wi-jo
u-ru-pi-ja-jo Confirmed? false
 -u-ru-pi-ja-jo
a-ko-so-ta Confirmed? false
 -a-ko-so-ta
 -a-ko-so-ta-o
po-ro-u-te Confirmed? false
 -po-ro-u-te-u
 -po-ro-u-te-we
```



We can use the inflections with a similarity of 3 to build the graph of related characters

Creating the Connections

- Kober showed how characters are connected
  - Computerise this process
- Predictable patterns, evidence of inflection
- Then this is plot on a graph



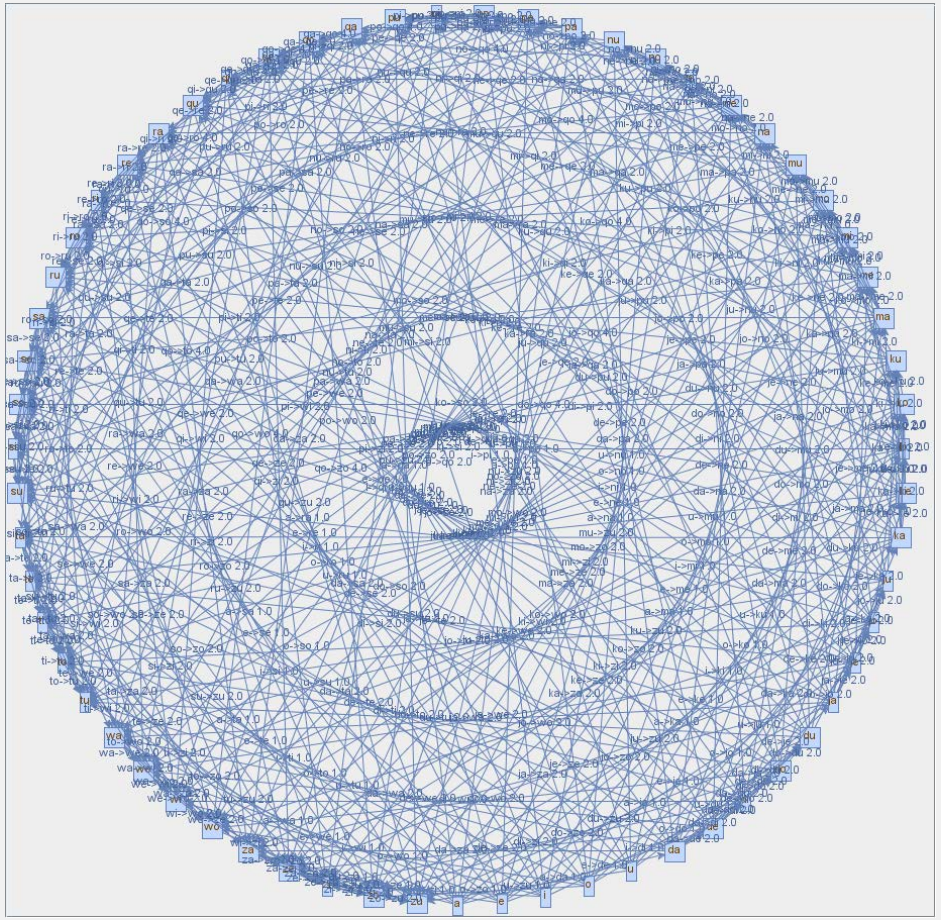
Ser-vu-s(a) -> Servus
Ser-vu-m(a) -> Servum
Ser-vi -> Servi

Same word – different case

First characters are the same, next character is the same, the next character likely shares a consonant

First characters are the same, next character likely shares a vowel

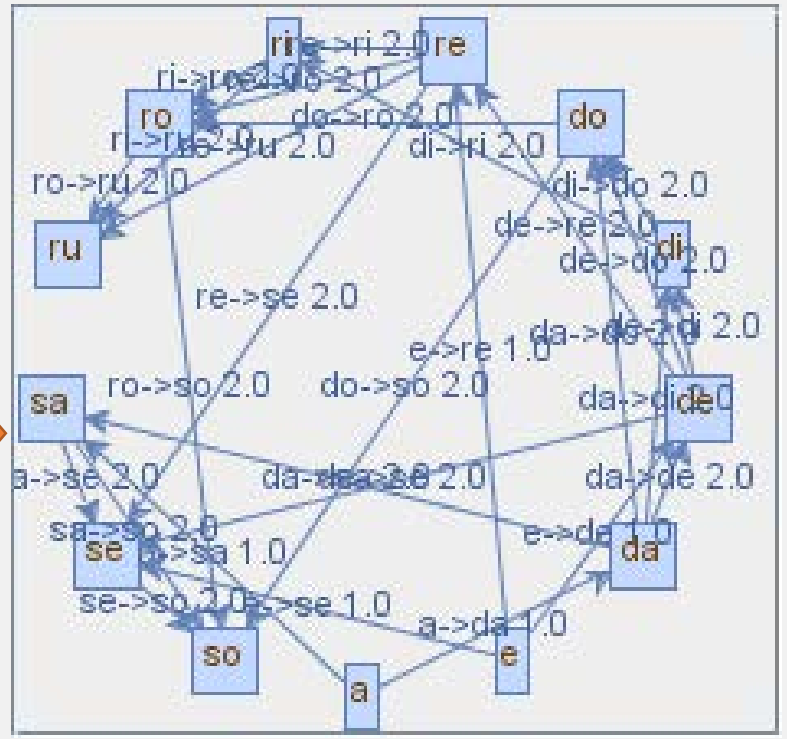
Connection Results



- Graph
  - Node -> A Linear B character
  - Edge -> A shared vowel or consonant
  - Weight -> How often it appears
- Plot onto a table

Final Grid

	A	E	I	O	U
	a	e	i	o	u
M	ma	me	mi	mo	mu
N	na	ne	null	no	nu
D	da	de	di	do	du
J	ja	je	ni	jo	ju
K	ka	ke	ki	ko	ku
P	pa	pe	pi	po	pu
Q	qa	qe	qi	qo	qu
R	ra	re	ri	ro	ru
S	sa	se	si	so	su
T	ta	te	ti	to	tu
Z	za	ze	zi	zo	zu
W	wa	we	wi	wo	null



Conclusion

- It is possible to replicate the decipherment of Linear B computationally
  - Different approach that typical Machine Learning decipherments
- Working with limitations can encourage creative solutions
  - Graph approach - computers are very good at working with them!
- Interdisciplinary projects are great sources of personal growth
  - Archaeology and Computer Science
  - These can join together!
    - Algorithms from unexpected sources
    - Spend more time with non-computer scientists
      - More creative solutions to problems
    - Changed how I approach problems

Thank you for listening

Any Questions?

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medium.com/@InsiderPhD/

https://github.com/greenpencil

My Linear B datasets are available and free for use
https://github.com/InsiderPhD/Linear-B-Dataset
My inflection algorithm is available and free for use
https://github.com/greenpencil/Java-Inflection-Algorithm