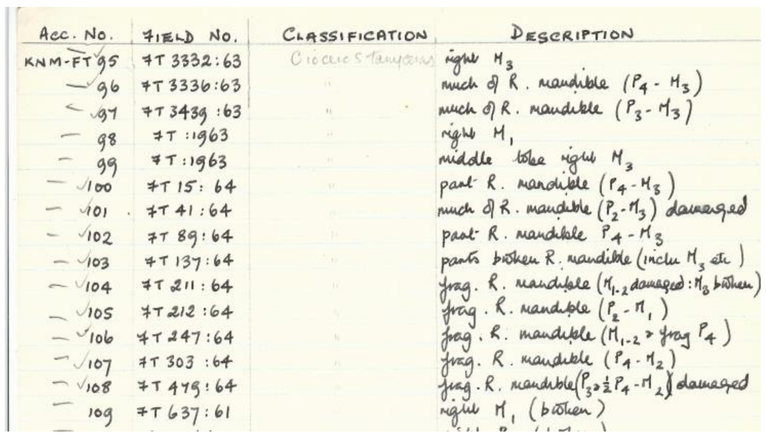
Digitization of handwritten fossil catalogues of the National Museum of Kenya

1. Extract words with optical character recognition (Azure Vision API)



Acc. No.	Field No.	Classification	Description
KNM-FT 95	7T 3332:63	Ció ceros Tamyoua	right M_3
96	7T 3336:63		much of R. mandible (P_4 - M_3)
97	7T 3439 :63		much of R. mandible (P_3 - M_3)
98	7T :1963		right M_1
99	7T :1963		middle tobe right M_3
100	7T 15: 64		pant R. mandible (P_4 - M_3)
101	7T 41 :64		much of R. mandible (P_2 - M_3) damaged
102	7T 89: 64		pant R. mandible P_4 - M_3
103	7T 137 :64		parts broken R. mandible (inclu M_3 etc)
104	7T 211 : 64		frag. R. mandible ($M_{1,2}$ damaged : M_3 bothen)
105	7T 212 :64		frag. R. mandible (P_2 - M_1)
106	7T 247 :64		frag. R. mandible (M_{1-2} > frag P_4)
107	7T 303 :64		frag. R. mandible (P_4 - M_2)
108	7T 419 :64		frag. R. mandible(P_3 > $\frac{1}{2}$ P_4 - M_2) damaged
109	7T 637 : 61		right M_1 (bothen)


```
"lines": [
    },
    {
        "text": "much of R. mandible (P4- H3)",
        "boundingPolygon": [
            {
                "x": 1385,
                "y": 284
            },
            {
                "x": 2233,
                "y": 282
            },
            {
                "x": 2233,
                "y": 358
            },
            {
                "x": 1385,
                "y": 359
            }
        ],
        "words": [
            {
                "text": "much",
                "boundingPolygon": [
                    {
                        "x": 1388,
                        "y": 295
                    },
                    {
                        "x": 1507
```


2. Table Inference

Data Science Project, spring 2024

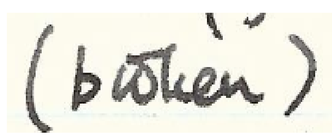
Rows: DBSCAN clustering
Columns: Hard-code common header names
Find headers on page
Assign each word under the header with x-direction middle point closest to word's x-direction middle point

ACC_NO	FIELD_NO	CLASSIFICATION	DESCRIPTION	TOOTH_RECORDS
KNM-FT 95	7T 3332:63	Ció ceros Tamyoua	M3	
96	7T 3336:63	much	of R. mandible (P4- H3)	
	7T 3439 : 63	much	of R. mandible (P3-M3)	
98	7T : 1963	right	M.	
99	#T : 1963		middle tobe right M2	
100	++ 15:64	pant	R. mandible (P4-M3)	
101	7T 41:64	much	of R. mandible (P2-M3) damaged	
102	7T 89:64	paul-	R. Mandible P4-M3	
−103	7T137:64	parts	broken R. mandible (inclu M2 etc)	
−104	7T 211: 64	frag.	R. mandible (M1, damaged: M3 bother)	
105	7T 211: :64		frag. R. Mandible (P. M.)	
~106	7T247:64	Jag.	R. mandible (M1-2 > frag P4)	
/107	#T 303 :64		Jurag. R. Mandible (PA-M2)	
V108	7T 419:64	Jag	. R. mandible (P == P4-M 2) damaged	
9	IT 637:61	right	M (broken)	

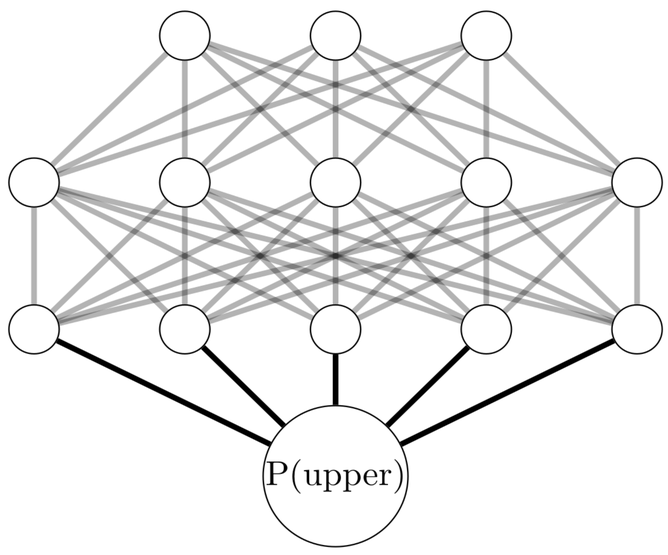
Unsolved: how to get teeth in description cleaned to tooth_records?

3. Element description cleaning

MSc thesis, "Fine-tuned optical character recognition for dental fossil markings"



Convolutional neural network, eg. AlexNet [1]
Transfer learning: Freeze all but last layer(s), train to classify characters



Output: class probability

"H1" → YES → M → lower → 1 → "m1"

Tooth or not?
Regular expression match: letter + digit

CLASSIFIER 1: M, P, I, C?

CLASSIFIER 2: upper, lower?

CLASSIFIER 3: 1, 2, 3, 4?

combine

concatenate

"m1 (broken)"

"(broken)" → NO → "(broken)"

End goal

ACC_NO	FIELD_NO	CLASSIFICATION	DESCRIPTION	TOOTH_RECORDS
KNM-FT 95	7T 3332:63	Ció ceros Tamyoua	m3	(m3)
96	7T 3336:63	much	of R. Mandible (p4- m3)	(p4, m3)
	7T 3439 : 63	much	of R. Mandible (p3-m3)	(p3, m3)
98	7T : 1963	right	m1	(m1)
99	#T : 1963		middle tobe right m3	(m3)
100	++ 15:64	pant	R. Mandible (p4-m3)	(p4, m3)
101	7T 41:64	much	of R. Mandible (p2-m3) damaged	(p2, m3)
102	7T 89:64	paul-	R. Mandible p4-m3	(p4, m3)
−103	7T137:64	parts	broken R. Mandible (inclu m3 etc)	(m3)
−104	7T 211: 64	frag.	R. Mandible (m1-2, damaged: m3 bothe	(m1, m2, m3)
105	7T 211: :64		frag. R. Mandible (p4. M2.)	(p2, m1)
~106	7T247:64	Jag.	R. Mandible (m1-2 > frag p4)	(m1, m2, p4)
/107	#T 303 :64		Jurag. R. Mandible (p4-m2)	(p4,m2)

Challenges

- Errors in column division
- Errors in line splitting to words by Azure
  - imperfect inputs to downstream models

Suggestion for future work: word bounding box detection model trained on fossil catalogues

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References

[1] A. Krizhevsky, I. Sutskever, and G. E. Hinton. “ImageNet Classification with Deep Convolutional Neural Networks”. In: *Advances in Neural Information Processing Systems*. Vol. 25. Curran Associates, Inc., 2012.

Acknowledgements

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