An end-to-end neural model based on cliques and scopes for frame extraction in long breast radiology reports

Perceval Wajsbürt [1,2], Xavier Tannier [2]

Greater Paris University Hospitals (APHP)[1], LIMICS, Sorbonne Université [2]

1. Introduction

We present a novel method to extract procedure, score, and lesion frames, i.e. labelled groups of entities, in long breast radiography reports. We propose the concept of scope relation and design a clique-based mechanism to handle overlapping frames. We evaluate our end-to-end method on a new dataset of breast radiology reports.

2. End to end extraction overview

3. Focus on the frame extraction

Why cliques ? If we only consider relations between trigger (e.g., "cyst") & attribute (e.g.,"2cm") entities, we cannot choose between combinations of attributes : to detect if "8 o'clock" relates to the "2cm" or "3cm" cyst, we need to predict relations between all entities, and extract the largest groups where all entities are linked: maximal cliques.

A scope is a contiguous text area on which an entity convey its meaning (e.g., "Left" on its section). We link an entity with every other entity in its scope. To handle discontinuous scopes, we mix the r^{scope} relations scores with a simpler biaffine product $r^{biaffine}$ between embeddings of entities.

Architecture:

4. Dataset

We annotated entities and relations in clinical reports of breast radiology. Scopes were not annotated, as they are inferred by the model.

	Train	Test
Docs count	80	40
Avg words / doc	361	362
Entities count	4070	2002
Frames count	1577	752

5. Results

	Frame support			Frame label		
Type	P	R	F1	P	R	F1
ACR score	89.6	95.7	92.5	80.6	86.1	83.3
Density	84.9	96.9	90.5	82.6	94.3	88.1
Diag proc	82.1	91.7	86.6	74.0	82.7	78.1
Ther proc	86.2	87.1	86.6	68.3	69.0	68.6
Finding	74.0	82.4	78.0	59.6	66.5	62.9
Overall	81.1	90.0	85.3	68.7	76.2	72.2

Frame extraction performance per frame type

	Frame support	Frame label
Full model	85.3	72.2
W/o scopes	81.1 (−4.2)	67.3 (−4.9)
W/o relative attn	84.0 (−1.4)	70.5 (−1.8)
W/o constraints	84.0 (−1.4)	69.4 (−2.8)

Ablations: 1. removing scopes (only using $r^{biaffine}$), 2. using standard instead of relative attention, 3. not preventing impossible relations like $size \leftrightarrow score$

6. Visualized scopes

Inferred latent scopes can help understand the prediction : each column shows the scope of the entity in white:

7. Conclusion

We introduced scope relations and a clique-based method to extract overlapping frames in clinical documents. We obtained promising results on a new dataset of breast radiology reports, and showed how latent scopes help understand the predictions. Future work will evaluate this approach on other tasks such as event extraction.