Mining Possessions: Existence, Type and Temporal Anchors

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What is Possession?

Possession – one entity belongs to another

Possessor – Person, Organization, Location

Possessee – Physical/Abstract Entity

Abstract : John has a cold.

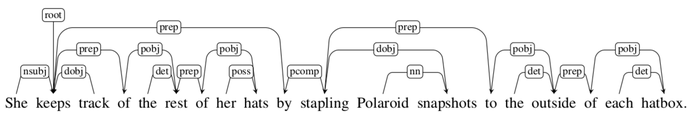
Inalienable : John hurt his arm.

Alienable : John drove his car.

Control : John was reading Mary's book.

Possessor – Possessee pair generation

- On top of OntoNotes
- Possessor – Named Entity Person or the personal pronouns ***I, We, He, She, They*** that are nominal subjects of a verb.
- Possessee – Nouns subsumed by the chosen synsets of WordNet that are reachable from the same verb.



Pairs generated: (She, hats) and (She, hatbox)

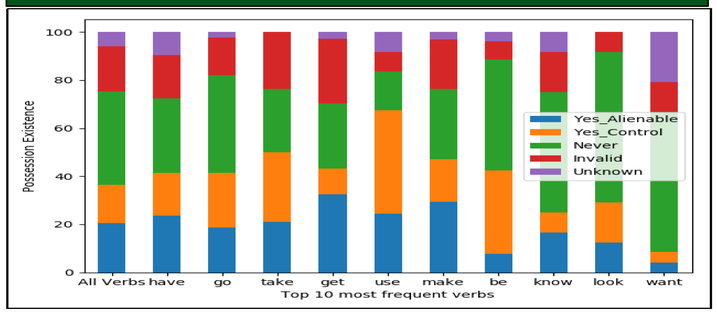
Labels

Possession Existence -
(Yes/Never/Unknown/Invalid)
Possession Type -
(Alienable/Control)
Possession Duration -
(Before/During/After)

Examples

Sentence of interest	Label	Before	During	After
But he had extreme mood swings and died in a car crash driving to work when I was five.	Alienable	✓	✓	✗
After moving to the unoccupied zone, Wang began carving seals in his spare time to support himself.	Alienable	✗	✗	✓
He kept my father's car for a year, without writing a confiscation order for it.	Control	✗	✓	✗
I just felt a large – not so much a bang, but, to me, where I was, it felt like something rammed the ship.	Control	✓	✓	✓
Latoya also described being awakened in the night, by Joseph wearing a "monster mask".	Never	N/A		
They asked him to come to them immediately, because the reported car had been seized.	Unknown	N/A		
Will your political party straighten up and say, damn it, we have to drop some of our ideological baggage?	Invalid	N/A		

Corpus Analysis

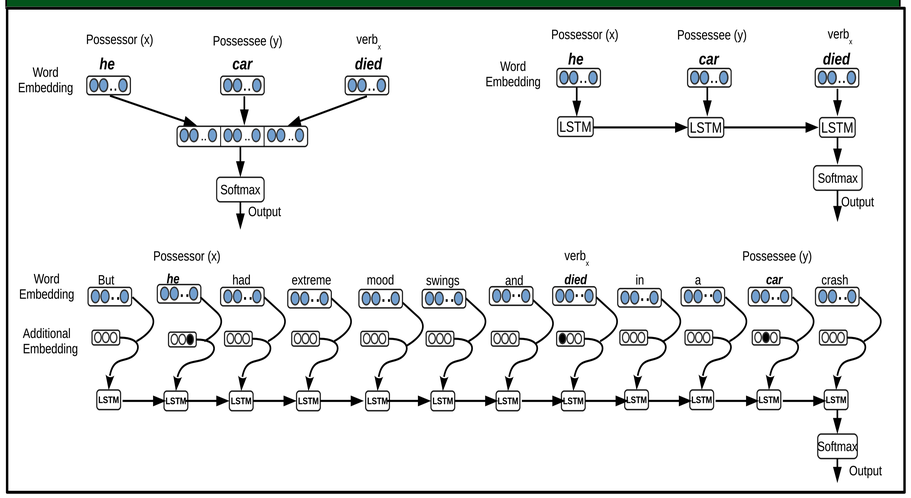


Experiments

SVM:
Features adapted from Gildea et al. + WordNet Features + Possession features

Neural Networks:
Feed Forward Network – Possessor + Possessee + Verb
LSTM - Possessor + Possessee + Verb
LSTM – Entire sentence + Additional embeddings for Possessor, Possessee and Verb

Neural Network Architectures



Results

Classifiers	Labels	Majority Baseline			SVM			FFNN			LSTMppv			LSTMsent		
		P	R	F1	P	R	F1	P	R	F1	P	R	F1	P	R	F1
Possesion Existence	Yes	0	0	0	0.57	0.65	0.61	0.54	0.53	0.54	0.65	0.69	0.67	0.74	0.72	0.73
	Never	0.41	1	0.58	0.61	0.53	0.56	0.59	0.59	0.59	0.71	0.79	0.75	0.73	0.82	0.77
	Unknown	0	0	0	0.44	0.43	0.44	0.56	0.59	0.58	0.75	0.49	0.59	0.49	0.59	0.8
	Weighted Avg.	0.17	0.41	0.24	0.56	0.56	0.56	0.57	0.57	0.57	0.7	0.69	0.69	0.75	0.75	0.74
Possession Type	Alienable	0.56	1	0.72	0.64	0.57	0.61	0.68	0.75	0.71	0.67	0.8	0.73	0.67	0.6	0.63
	Control	0	0	0	0.53	0.59	0.56	0.64	0.56	0.6	0.67	0.5	0.57	0.56	0.62	0.59
	Weighted Avg.	0.32	0.56	0.4	0.59	0.58	0.58	0.66	0.67	0.66	0.66	0.67	0.67	0.62	0.61	0.61

Conclusion

- Deterministically generated 979 potential (possessor, possessee) pairs on top of OntoNotes.
- Manually validated the pairs for possession existence, possession type and temporal anchors.
- Inter annotator agreement is substantial. (Possession Existence: 0.79, Possession Type: 0.77, Before: 0.68, During: 0.75, After: 0.59).
- Experimented with SVM, Feed Forward Neural Networks and LSTMs.
- Results show that the task can be automated.

Applications: Recommendation systems, Provenance document generation