Extracting Relational Facts by an End-to-End Neural Model with Copy Mechanism

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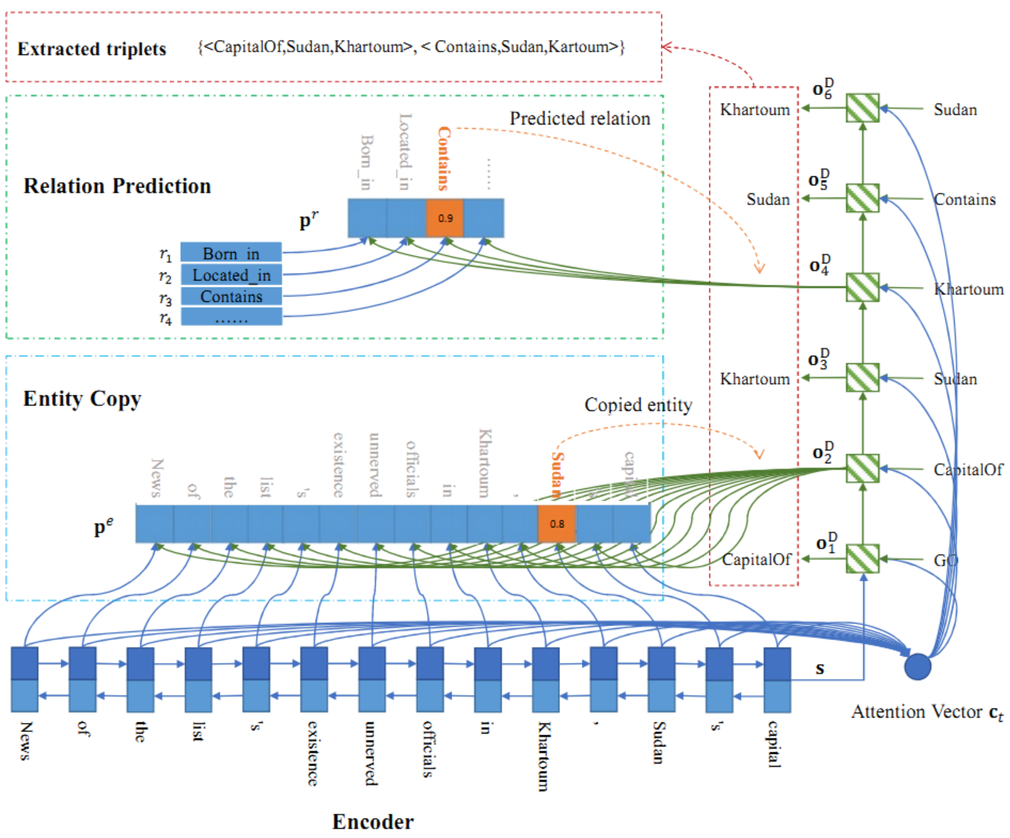
Motivation

- Relational triplets may have overlaps in a sentence.
- We divide the sentences into three types according to triplet overlap degree: Normal, EntityPairOverlap (EPO) and SingleEntityOverlap (SEO).
- Current work mainly concentrate on relation extraction of Normal class.

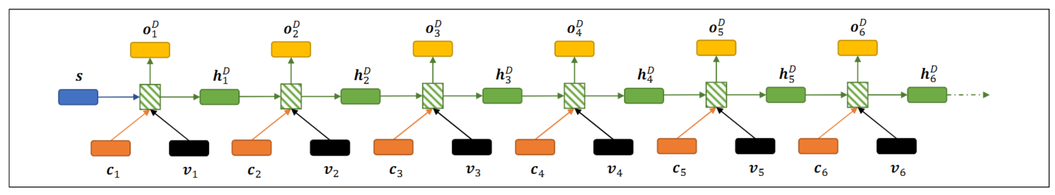
Normal	S1: Chicago is located in the United States. {<Chicago, country, United States>}	Chicago — country — United States
EPO	S2: Celery is an ingredient of Bakso, a dish from the country of Indonesia . {<Bakso, region, Indonesia>, <Bakso, country, Indonesia>}	Bakso — region / country — Indonesia
SEO	S3: Aarhus airport serves the city of Aarhus who's leader is Jacob Bundsgaard. {<Aarhus, leaderName, Jacob Bundsgaard>, <Aarhus Airport, cityServed, Aarhus>}	Jacob Bundsgaard — leaderName — Aarhus — cityServed — Aarhus Airport

Methods

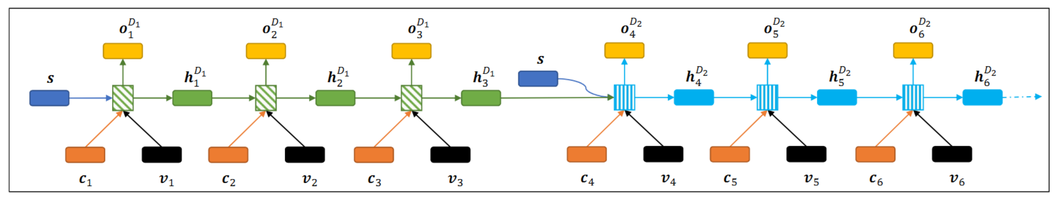
- We aim to design a model that could extract triplets from sentences of Normal, EPO and SEO classes.
- We propose an end2end model based on Seq2Seq learning with copy mechanism.
  - The encoder converts a natural language sentence (the source sentence) into a fixed length semantic vector
  - Then, the decoder reads in this vector and generates triplets directly.
    - To generate a triplet, firstly, the decoder generates the relation
    - Secondly, by adopting the copy mechanism, the decoder copies the first entity (head entity) from the source sentence
    - Lastly, the decoder copies the second entity (tail entity) from the source sentence.
- We adopt two different strategies in decoding process:
  - Employing only one unifies decoder (OneDecoder) to generate all triplets
  - Or, applying multiple separated decoders (MultiDecoder) and each of them generating one triplet.



- The inputs and outputs of the decoder(s) of OneDecoder model and MultiDecoder model.
  - (a) is the decoder of OneDecoder model. Only one decoder (the green rectangle with shadows) is used and this encoder is initialized with the sentence representation s.
  - (b) is the decoders of MultiDecoder model. There are two decoders (the green rectangle and blue rectangle with shadows). The first decoder is initialized with s; Other decoder(s) are initialized with s and previous decoder's state.



(a)



(b)

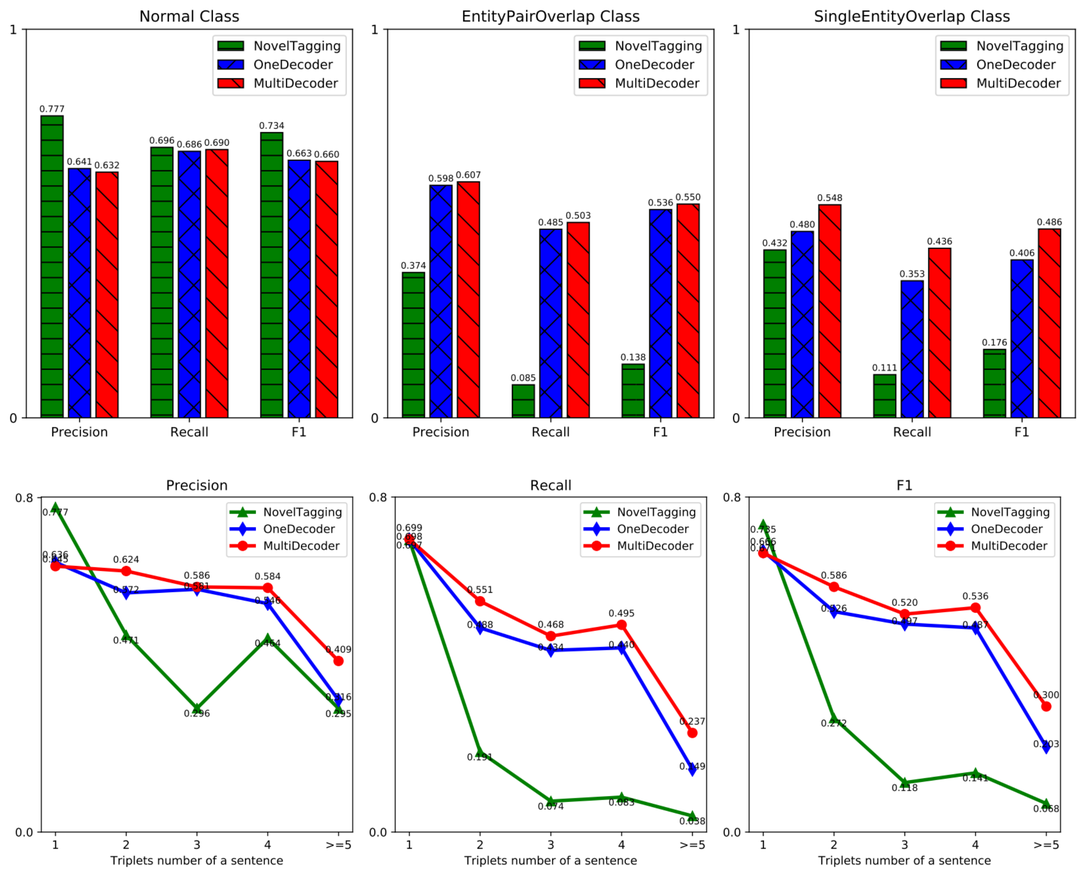
Experiments

- Datasets: NYT and WebNLG
- Baseline: NovelTagging (ACL2017)

Class	NYT		WebNLG	
	Train	Test	Train	Test
Normal	37013	3266	1596	246
EPO	9782	978	227	26
SEO	14735	1297	3406	457
ALL	56195	5000	5019	703

- Results of different models

Model	NYT			WebNLG		
	Precision	Recall	F1	Precision	Recall	F1
NovelTagging	**0.624**	0.317	0.420	**0.525**	0.193	0.283
OneDecoder	0.594	0.531	0.560	0.322	0.289	0.305
MultiDecoder	0.610	**0.566**	**0.587**	0.377	**0.364**	**0.371**



Model	NYT	WebNLG
OneDecoder	0.858	0.745
MultiDecoder	0.862	0.821

Table 3: F1 values of entity generation.

Model	NYT	WebNLG
OneDecoder	0.874	0.759
MultiDecoder	0.870	0.751

Table 4: F1 values of relation generation.

Contribution

- **We propose an end2end neural model based on sequence-to-sequence learning with copy mechanism to extract relational facts from sentences, where the entities and relations could be jointly extracted.**
- **Our model could consider the relational triplet overlap problem through copy mechanism. In our knowledge, the relational triplet overlap problem has never been addressed before.**
- **We conduct experiments on two public datasets. Experimental results show that our model outperforms the state-of-the-arts with 39.8% and 31.1% improvements respectively.**