DEGREE: A Data-Efficient Generation-Based Event Extraction Model

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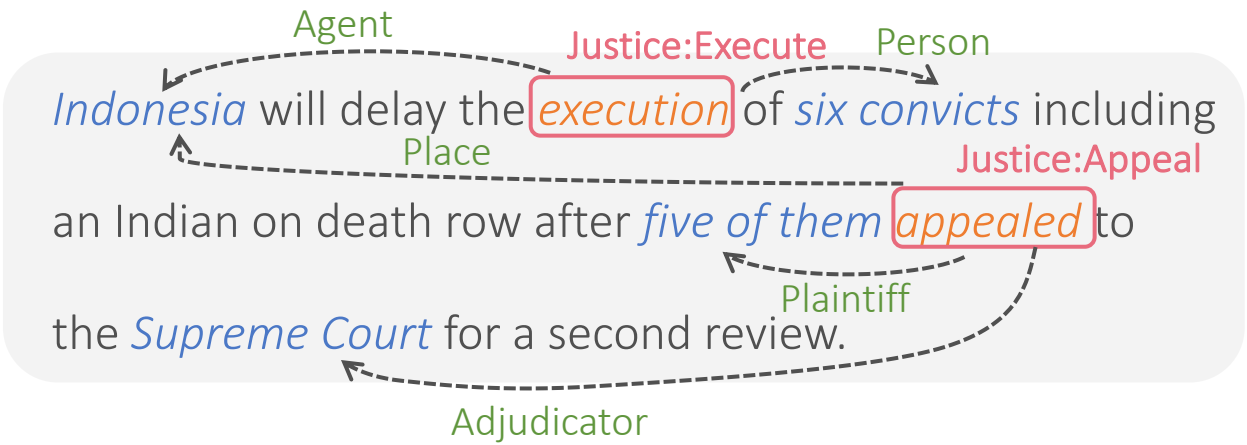
Event extraction

- Goal: extract **events** described in the given sentence
- Each event contains
  - an event trigger and its specific event type.
  - several participants (arguments) and their specific roles.



Justice:Execute	
Agent	Indonesia
Person	six convicts
Place	*None*

Justice:Appeal	
Plaintiff	five of them
Prosecutor	*None*
Adjudicator	Supreme Court
Place	Indonesia

Low-resource event extraction

- Event annotations are expensive.
  - Different event structure for different type
  - Especially in domains where annotators are hard to get, such as biomedical domain

- Can we learn an event extraction model with **only a few** annotations?

→ A data-efficient event extraction model !

Key factors for low-resource event extraction

- Label semantic
  - Semantic meaning of the label name
  - Semantic relation between roles

a ***person*** who brings suit in a court.

The adjudicator gives the plaintiff a chance to present their arguments and makes a final ruling.

Justice:Appeal	
Plaintiff	five of them
Prosecutor	*None*
Adjudicator	Supreme Court
Place	Indonesia

- Dependencies of an event
  - Shared knowledge for predicting triggers and arguments
  - Consider the final prediction jointly.

It is rare that a plaintiff being the same with the adjudicator in an event.

Previous approaches

- Most classification-based models, such as DyGIE++ [Wadden+ 2019], or OneIE [Lin+ 2020]
  - Do not leverage label semantics.
  - Labels are represented as numerical categories.
- Recent generation-based models
  - Either do not fully incorporate label semantic, e.g. the semantic relation between roles, such as TANL [Paolini+ 2021] or Text2Struct [Lu+ 2021]
  - Or do not fully exploit event dependencies, such as BART-Gen [Li+ 2021].

DEGREE: a data-efficient generation-based EE model

We formulate event extraction as a conditional generation problem

Event Trigger	*detonated*
Attacker	*Palestinian*
Target	*jeep, soldiers*
Instrument	*bomb*
Place	*Gaza Strip*

Decode the output sequence into final predictions

Autoregressive generation considers dependencies

Output

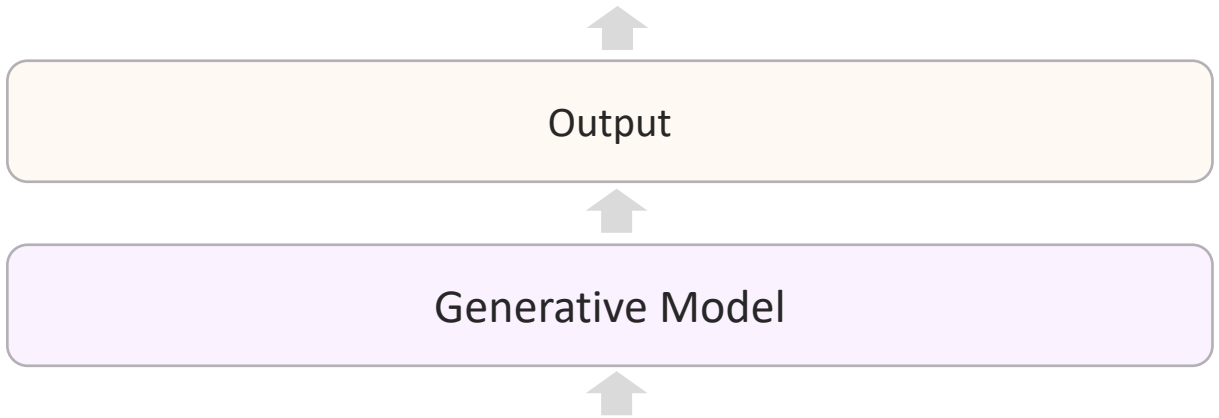
Generative Model

Earlier Monday , a 19-year-old *Palestinian* riding a bicycle *detonated* a 30-kilo (66-pound) *bomb* near a military *jeep* in the *Gaza Strip* , injuring three *soldiers*.

DEGREE: a data-efficient generation-based EE model

How can we exploit label semantics?

Event Trigger	*detonated*
Attacker	*Palestinian*
Target	*jeep, soldiers*
Instrument	*bomb*
Place	*Gaza Strip*

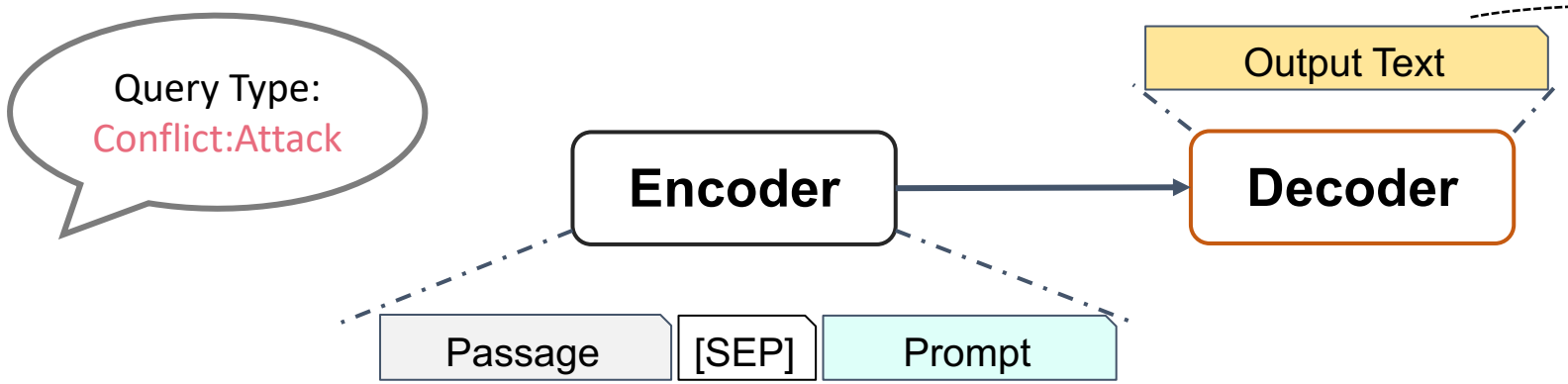


Earlier Monday , a 19-year-old *Palestinian* riding a bicycle *detonated* a 30-kilo (66-pound) *bomb* near a military *jeep* in the *Gaza Strip* , injuring three *soldiers*.

<SEP>

Prompt

DEGREE: a data-efficient generation-based EE model



Event Trigger	*detonated*
Attacker	*Palestinian*
Target	*jeep, soldiers*
Instrument	*bomb*
Place	*Gaza Strip*

Passage: *Earlier Monday , a 19-year-old Palestinian riding a bicycle detonated a 30-kilo (66-pound) bomb near a military jeep in the Gaza Strip , injuring three soldiers.*

Prompt	
Event Type Description	*The event is related to conflict and some violent physical act.*
Event Keywords	*Similar triggers such as war, attack, terrorism.*
E2E Template	*Event trigger is <Trigger>. \n some attacker attacked some facility, someone, or some organization by some way in somewhere.*
Output Text	
Event trigger is detonated. \n Palestinian attacked jeep and soldiers by bomb in Gaza Strip.	

7

DEGREE: a data-efficient generation-based EE model

Passage: *Earlier Monday , a 19-year-old Palestinian riding a bicycle detonated a 30-kilo (66-pound) bomb near a military jeep in the Gaza Strip , injuring three soldiers.*

Natural language style placeholder reveals label attributes

Generation-based framework provides a flexible interface to incorporate these weakly-supervision signals

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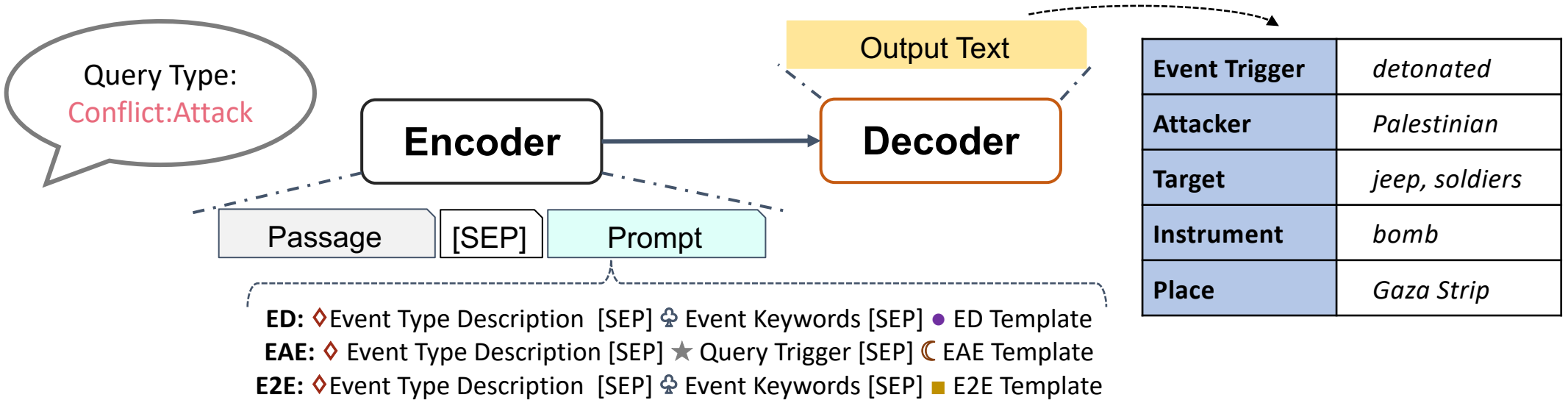
Event trigger is detonated. \n Palestinian attacked jeep and soldiers by bomb in Gaza Strip.	

The sentence structure depict the semantic relation between arguments.

DEGREE(Pipe) = DEGREE(ED) + DEGREE(EAE)



Event Trigger	*detonated*
Attacker	*Palestinian*
Target	*jeep, soldiers*
Instrument	*bomb*
Place	*Gaza Strip*

Prompt for **Event Detection (ED)**	
◊ **Event Type Description**	*The event is related to conflict and some violent physical act.*
♧ **Event Keywords**	*Similar triggers such as war, attack, terrorism.*
● **ED Template**	*Event trigger is <Trigger>.*
Output Text	
Event trigger is detonated.	

Prompt for **Event Argument Extraction (EAE)**	
◊ **Event Type Description**	*The event is related to conflict and some violent physical act.*
★ **Query Trigger**	*The event trigger word is detonated.*
☾ **EAE Template**	*some attacker attacked some facility, someone, or some organization by some way in somewhere.*
Output Text	
Palestinian attacked jeep and soldiers by bomb in Gaza Strip.	

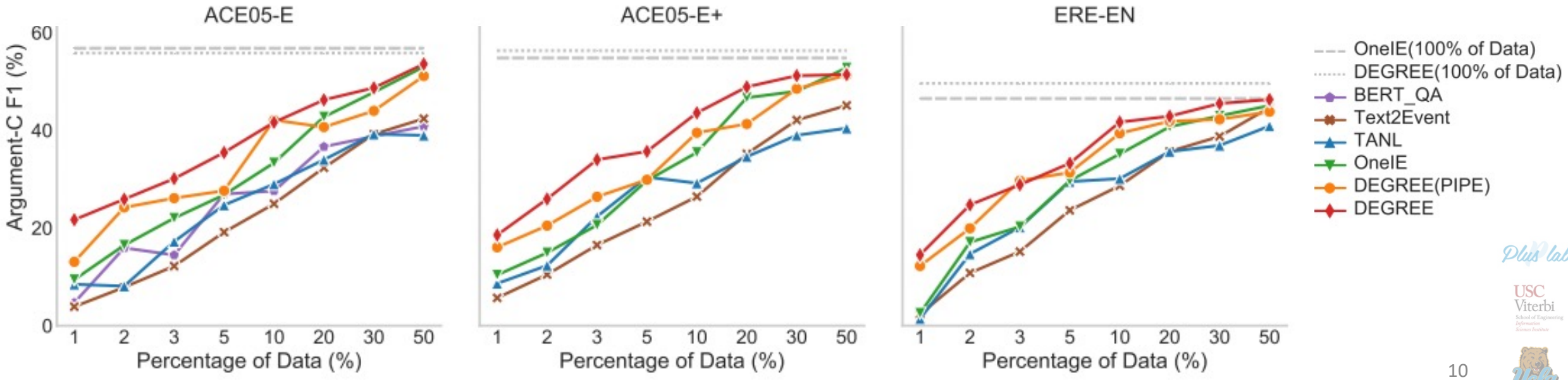
Main experiments

- Experiment on the two most widely-used dataset, ACE and ERE.
  - Better end-to-end argument F1 scores than baselines.
  - Classification-based baseline: BERT_QA [Du+ 2020], OneIE [Lin+ 2020]
  - Generation-based baseline: Text2Event [Lu+ 2021], TANL [Paolini+ 2021]

DEGREE is the best across almost all cases.

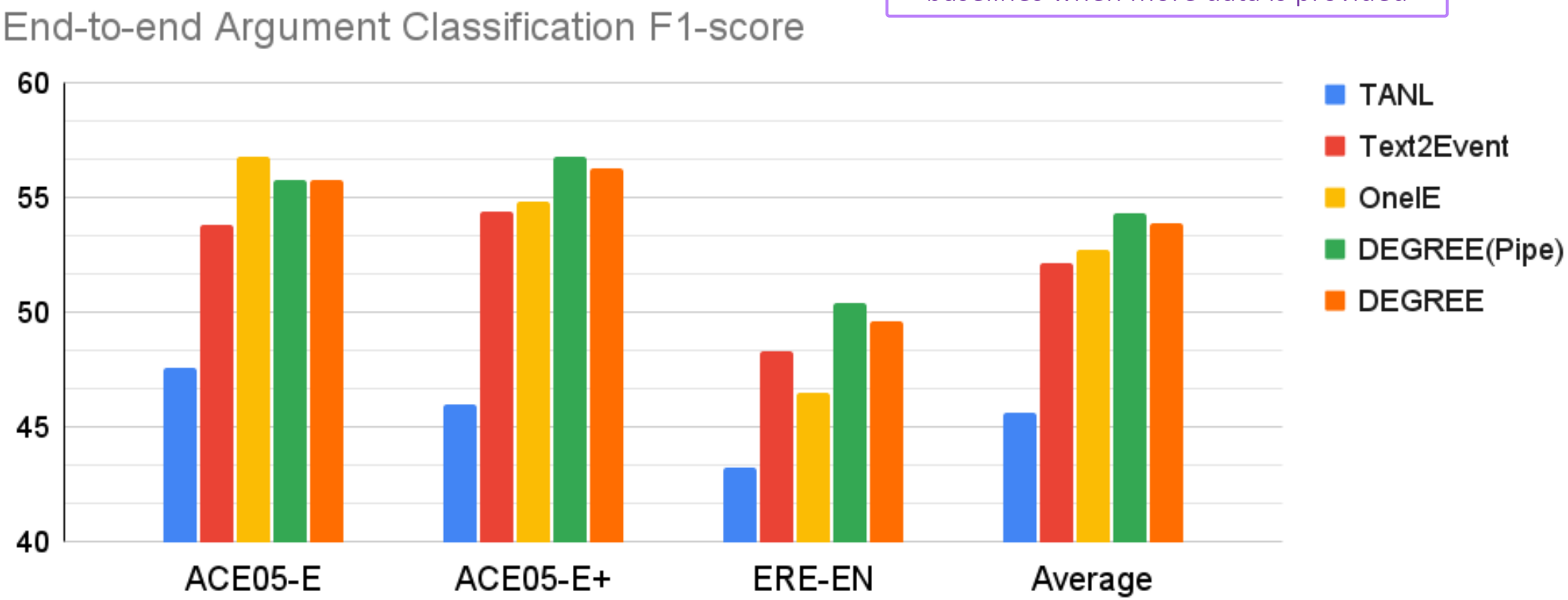
DEGREE is better than DEGREE(Pipe), especially when training data is fewer.

DEGREE does **not** require any entity labels.



Results under high-resource setting

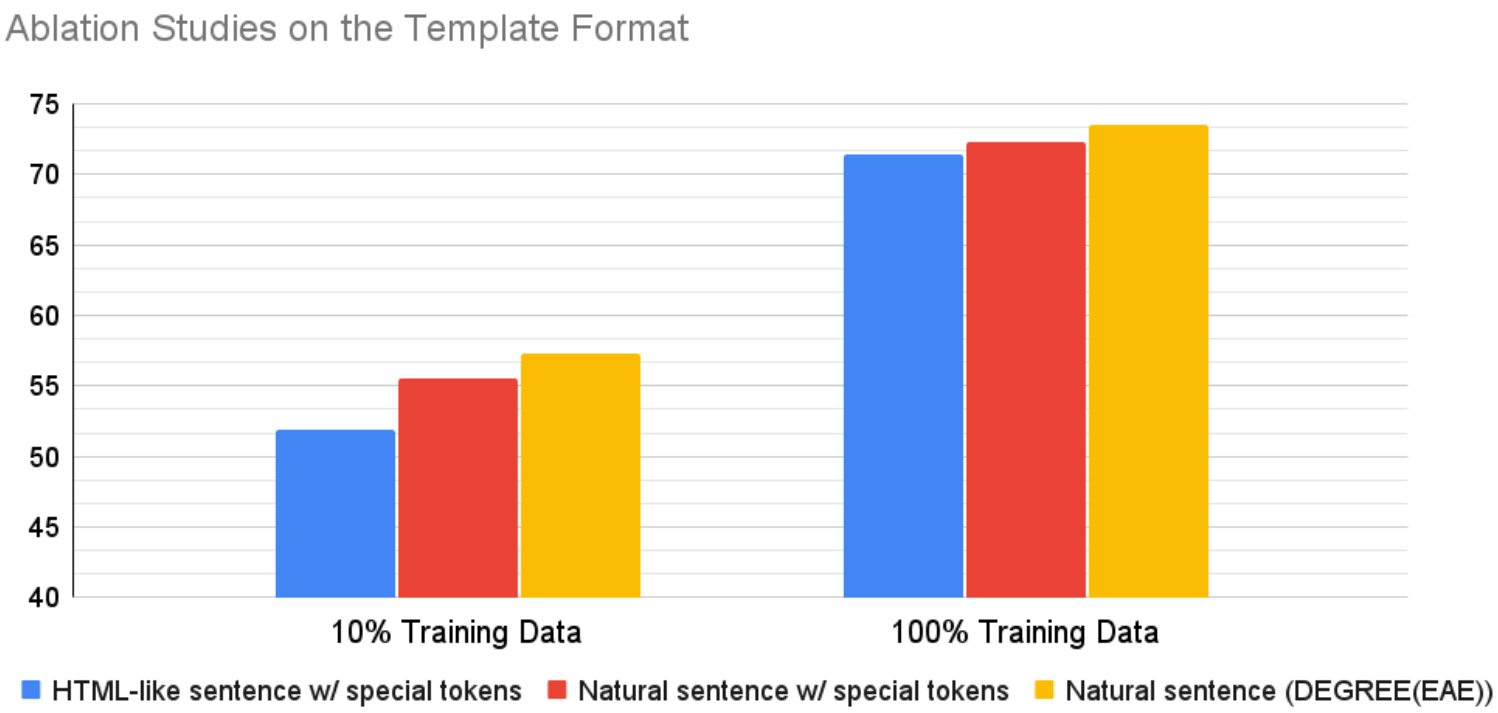
DEGREE outperform can also outperform baselines when more data is provided



Ablation studies on the template format

Does our label semantic enriched template design help?

- Yes



<Attacker> </Attacker> <Victim> </Victim> <Instrument> </Instrument> <Place> </Place>

<Attacker> attacked <Victim> by <Instrument> in <Place>.

some attacker attacked some facility, someone, or some organization by some way in somewhere.

Conclusion

- We propose DEGREE, a data-efficient generation-based event extraction model.
  - Exploits label semantics
  - Captures event dependencies
  - Flexible to incorporate weakly-supervised information
- Significant improvements over previous baselines, especially when only a few training data is available.

Code is available at
https://github.com/PlusLabNLP/DEGREE