



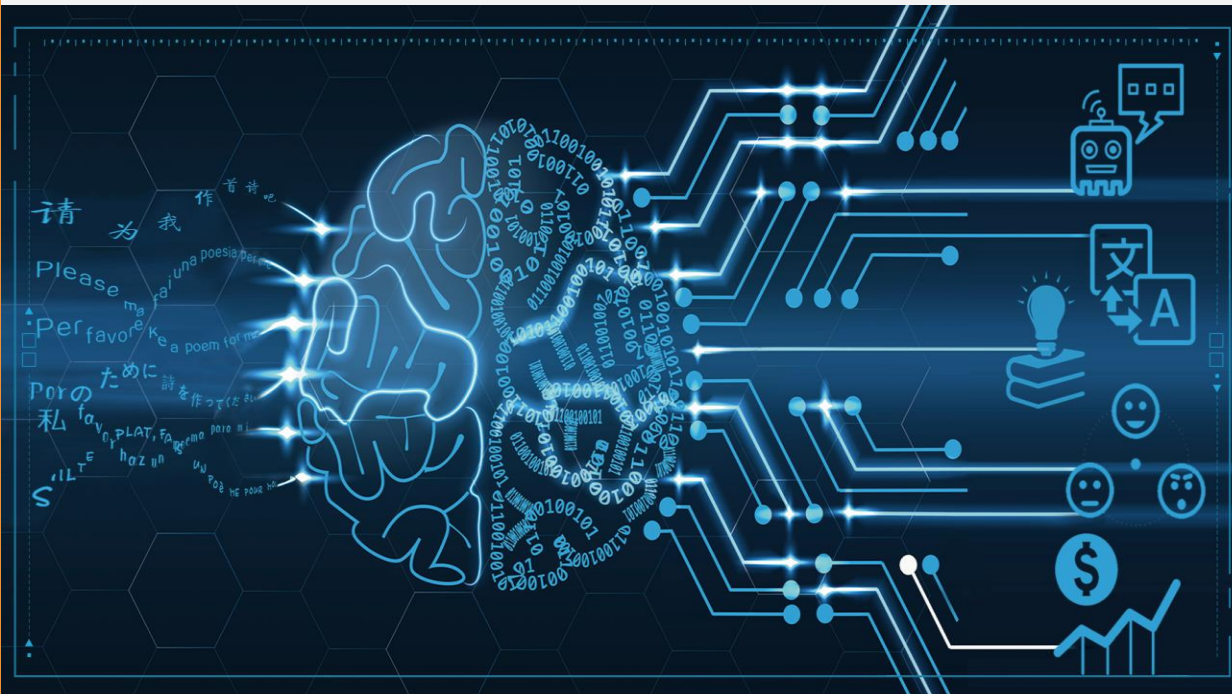
Contextualized Rewriting for Text Summarization

Guangsheng Bao and Yue Zhang, AAAI 2021



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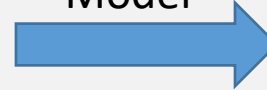
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Extractive Summarization

(CNN) The Tulsa county reserve deputy who fatally shot a man instead of using his taser turned himself in to authorities Tuesday at the Tulsa jail. Video shows reserve deputy Robert Bates announcing he is going to deploy his taser after an undercover weapons sting on April 2 but then shooting Eric Courtney Harris in the back with a handgun. Bates was charged with second-degree manslaughter Monday. He surrendered Tuesday morning, accompanied by his attorney and immediately posted bail of \$25,000. As he exited the jailhouse, Bates paused in front of television cameras for a moment but did not speak. ...

Classification
Model



Extractive Summary:

The Tulsa county reserve deputy **who fatally shot a man instead of using his taser** turned himself in to authorities Tuesday at the Tulsa jail.

Bates was charged with second-degree manslaughter Monday.

Gold Summary:

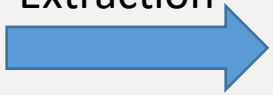
Tulsa county reserve deputy **Robert Bates** turns himself into authorities.

He is charged with second-degree manslaughter in the death of Eric Courtney Harris .

Background

Extractive + Rewriting Approach

Extraction

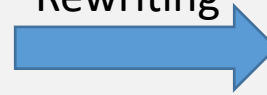


Extractive Summary:

The Tulsa county reserve deputy who fatally shot a man instead of using his taser turned himself in to authorities Tuesday at the Tulsa jail.

Bates was charged with second-degree manslaughter Monday.

Seq2seq
Rewriting



Rewritten Summary:

Tulsa county reserve deputy turns himself in to authorities.

Bates is charged with second-degree manslaughter.

Gold Summary:

Tulsa county reserve deputy **Robert Bates** turns himself into authorities.

He is charged with second-degree manslaughter **in the death of Eric Courtney Harris** .

Contextualized Rewriting

A Simple Example

Source Document: thousands of live earthworms have been falling from the sky in norway...*a biology teacher discovered the worms on the surface of the snow while he was skiing in the mountains near bergen at the weekend* ... teacher **karstein erstad** told norwegian news website the local ...

Gold Summary: teacher karstein erstad found thousands of live worms on top of the snow.

Extractive Summary: *a biology teacher discovered the worms on the surface of the snow while he was skiing in the mountains near bergen at the weekend.*

Rewritten Summary: biology teacher **karstein erstad** discovered the worms on the snow.

Figure 1: Example showing that contextual information can benefit summary rewriting.

Contextualized Rewriting

Group Alignments

Source Document: our resident coach and technical expert chris meadows has plenty of experience in the sport and has worked with some of the biggest names in golf.^① chris has worked with more than 100,000 golfers throughout his career. growing up beside nick faldo, meadows learned that success in golf comes through developing a clear understanding of, and being committed to, your objective. a dedicated coach from an early age, he soon realized his gift was the development of others. meadows simple and holistic approach to learning has been personally shared with more than 100,000 golfers in a career spanning three decades.^② many of his instructional books have become best-sellers, his career recently being recognized by the professional golfers' association when he was made an advanced fellow of the pga.^③ chris has been living golf's resident golf expert since 2003.

Rewritten Summary: chris meadows has worked with some of golf's big names.^① he has personally coached more than 100,000 golfers.^② chris was made an advanced fellow of the pga.^③

Figure 2: Example of three-step summarization process: selecting, grouping and rewriting.

Contextualized Rewriting

Seq2seq with Group Alignments

¹

$$\hat{Y} = \arg_Y \max_{Y, G_Y} P(Y, G_Y | X, G_X), \quad (3)$$

where

²

$$G_X = \{g_i = k \text{ if } w_i \in G_k \text{ else } 0\}_{i=1}^{|X|}, \quad (4)$$

$$G_Y = \{g_j = k \text{ if } w_j \in G_k \text{ else } 0\}_{j=1}^{|Y|}, \quad (5)$$

so that for each group G_k , a group tag k is assigned, through which the text segment from X in group G_k are linked to the segment from Y in the same group. For the example in

³

Figure 2, $G_X = \{1, \dots, 1, 0, \dots, 0, 2, \dots, 2, 3, \dots, 3, 0, \dots, 0\}$ and $G_Y = \{1, \dots, 1, 2, \dots, 2, 3, \dots, 3\}$.

Contextualized Rewriting

A DNN Implementation

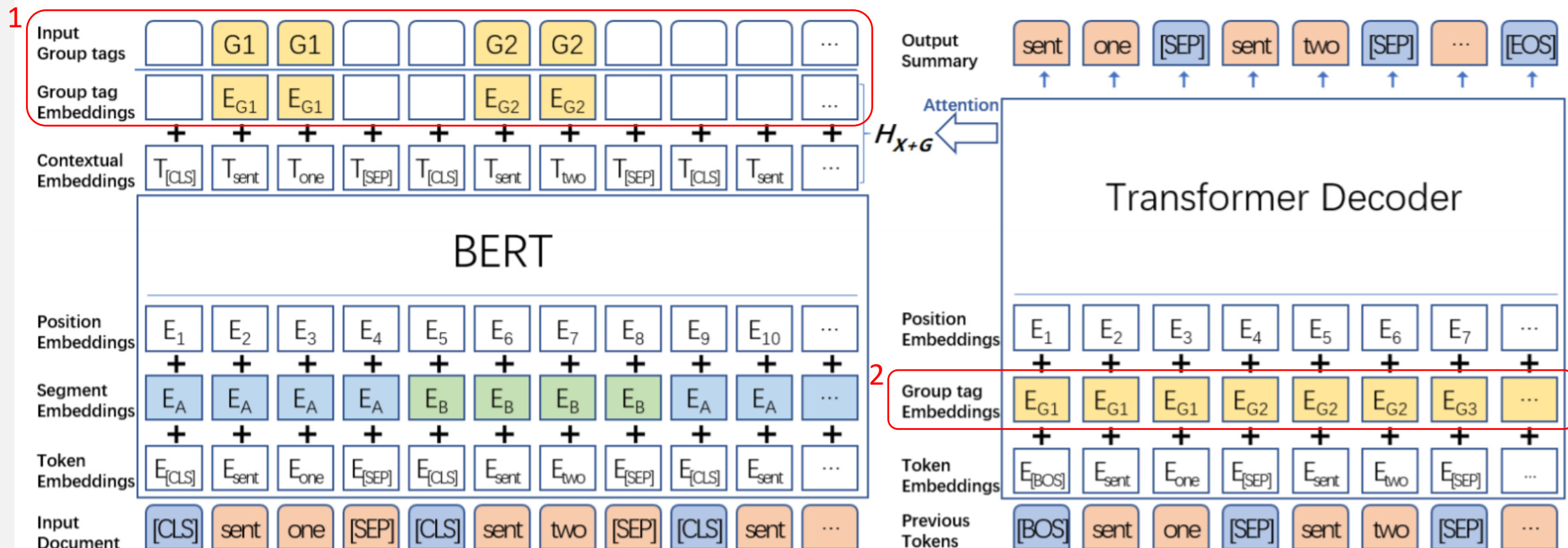
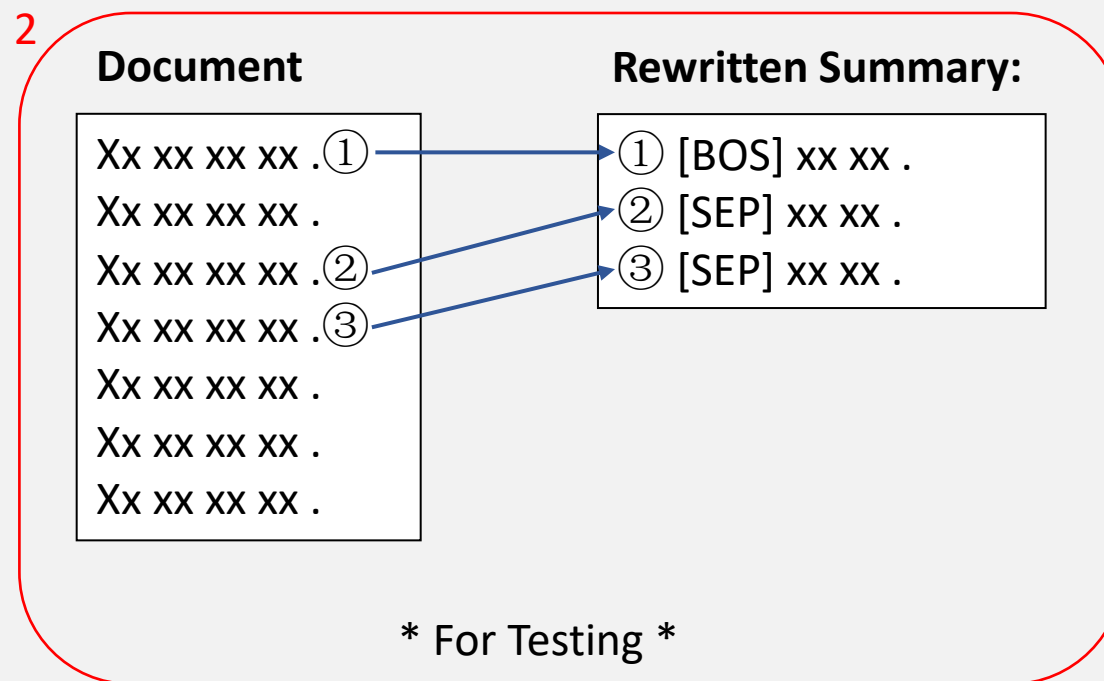
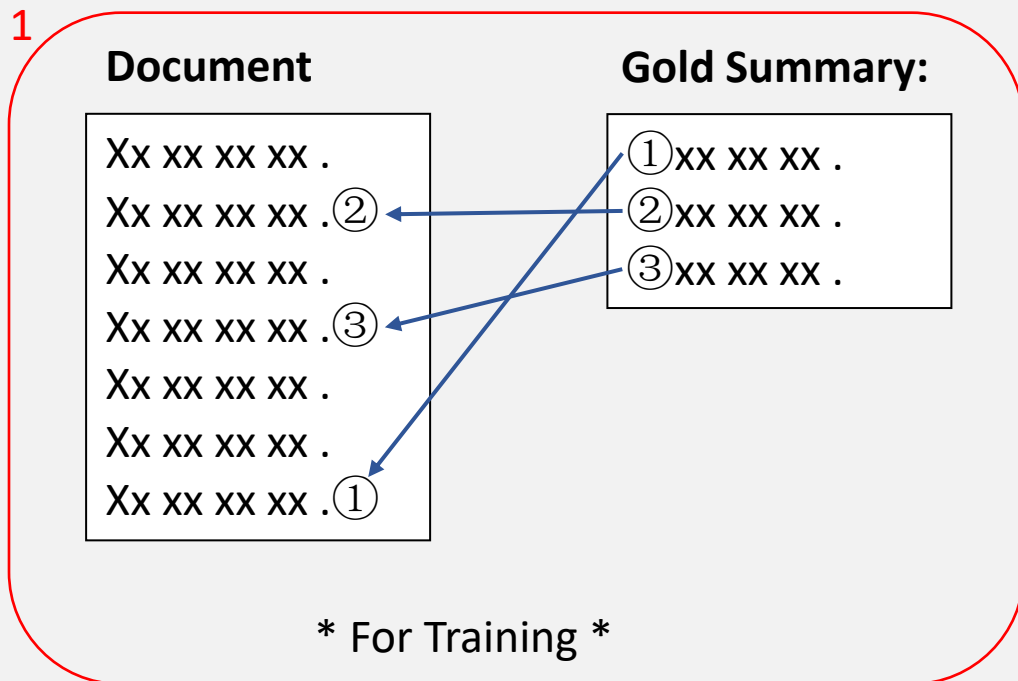


Figure 3: Architecture of the contextualized rewriter. The group tag embeddings are tied between the encoder (left figure) and the decoder (right figure), through which the decoder can address to the corresponding tokens in the document.

Contextualized Rewriting

Group Tagging



Experimental Results

Automatic Evaluation

(On CNN/DM dataset)

Method	ROUGE-1	ROUGE-2	ROUGE-L
Extractive			
LEAD-3 (See, Liu, and Manning 2017)	40.34	17.70	36.57
BERTSUMEXT (Liu and Lapata 2019)	43.25	20.24	39.63
Abstractive			
BERTSUMABS (Liu and Lapata 2019)	41.72	19.39	38.76
BERTSUMEXTABS (Liu and Lapata 2019)	42.13	19.60	39.18
RNN-Ext+Abs+RL (Chen and Bansal 2018)	40.88	17.80	38.54
BERT-Hybrid (Wei, Huang, and Gao 2019)	41.76	19.31	38.86
BERT-Ext+Abs+RL (Bae et al. 2019)	41.90	19.08	39.64
BERT+Copy/Rewrite+HRL (Xiao et al. 2020)	42.92	19.43	39.35
Our Models			
BERT-Ext	41.04	19.56	37.66
Oracle	46.77	26.78	43.32
BERT-Abs	41.70	19.06	38.71
BERT-Ext+ContextRewriter	43.52*	20.57*	40.56*
Oracle+ContextRewriter	52.57	29.71	49.69

Table 1: Results. The best scores are in bold, and significantly better scores are marked with * ($p < 0.001$, t-test). Ext and Abs denotes extractive and abstractive models, respectively, and RL means reinforcement learning.

Experimental Results

Human Evaluation

(On samples from CNN/DM dataset)

Method	Faith.	Read.	Info.	Conc.
RNN-Ext+Abs+RL	4.71	3.62	3.22	3.35
BERTSUMEXT	5.00	3.45	3.90	3.55
BERTSUMEXTABS	4.86	4.22	3.78	3.85
BERT-Ext+ContextRewriter	5.00	4.15	4.01	3.80

Table 2: Human evaluation on faithfulness (Faith.), readability (Read.), informativeness (Info.), and conciseness (Conc.).

Universality of the Rewriter

Method	ROUGE-1	ROUGE-2	ROUGE-L	Words
Oracle	46.77	26.78	43.32	112
+ ContextRewriter (ours)	52.57 (+5.80)	29.71 (+2.93)	49.69 (+6.37)	63
LEAD-3	40.34	17.70	36.57	85
+ ContextRewriter (ours)	41.09 (+0.75)	18.19 (+0.49)	38.06 (+1.49)	55
BERTSUMEXT w/o Tri-Bloc	42.50	19.88	38.91	80
+ ContextRewriter (ours)	43.31 (+0.81)	20.44 (+0.56)	40.33 (+1.42)	54
BERT-Ext (ours)	41.04	19.56	37.66	105
+ ContextRewriter (ours)	43.52 (+2.48)	20.57 (+1.01)	40.56 (+2.90)	66

Table 3: Results of four extractive summarizers applied with contextualized rewriter. Tri-Bloc means Trigram Blocking.

Reduce Redundancy

Extractive Summary: oratilwe hlongwane , whose dj name is aj , is still learning to put together words but the toddler is already able to select and play music from a laptop and has become a phenomenon in south africa .① two-year-old oratilwe hlongwane , from johannesburg , south africa , whose dj name is aj , is still learning to put together words but is already able to play music from a laptop , making him a worldwide phenomenon .②

Rewritten Summary: oratilwe hlongwane , whose dj name is aj , is still learning to put together words .① he is already able to play music from a laptop , making him a worldwide phenomenon .②

Figure 5: Example of the ability to reduce redundancy.

SECTION 4 Analysis

High Compression

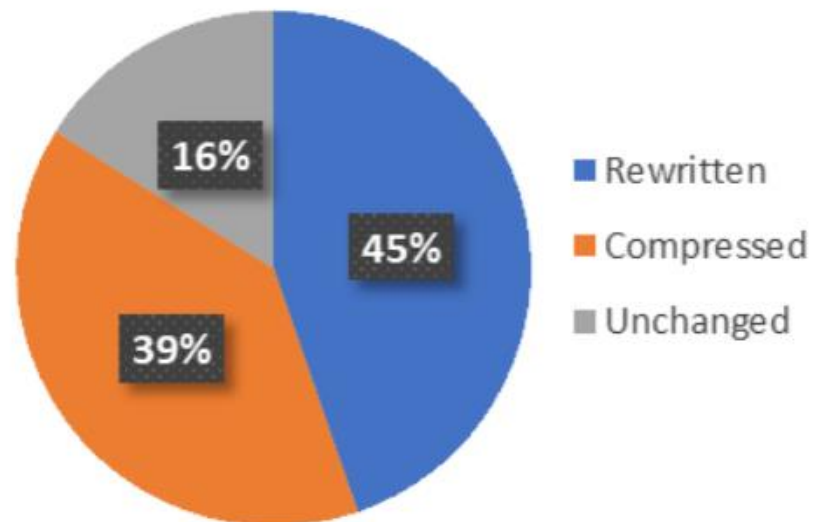


Figure 5: Proportion of compression, rewritten and unchanged sentences by a contextualized rewriter.

For instance, “*they returned to find hargreaves and the girl, who has not been named, lying on top of each other.*” is compressed into “*they returned to find hargreaves and the girl lying on top of each other.*”

Maintain Coherence

Source Document: a university of iowa student has died nearly three months after a fall ... andrew mogni , 20 , from glen ellyn , illinois , had only just arrived for ...① he was flown back to chicago via ...but he died on sunday .② ...

Rewritten Summary: andrew mogni , 20 , from glen ellyn , illinois , had only just arrived for a semester program in italy when the incident happened in january① he was flown back to chicago via air ambulance on march 20 , but he died on sunday②

Swap Group Tags: andrew mogni , 20 , was flown back to chicago via air ambulance on march 20 , but he died on sunday① he had only just arrived for a semester program in italy when the incident happened in january②

Figure 6: Example of the ability to maintain coherence.

Take Away

Contextualized Rewriting:

- Recall important information from context.
- Reduce redundant information.
- Remove unimportant phrases.
- Maintain coherence.
- Work with different extractive summarizers.

Q & A

Thank you!