

# Controlling keywords and their positions in text generation

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## 1. Introduction

- Previous studies proposed specifying the keywords that should be included in the generated text to control text generation.
- The user may want to reflect the intended importance of each keyword in the generated text, and an effective way to do this is to adjust the position of keywords within the text.
  - For example, placing an important keyword such as topic words and eye-catching words at the beginning of the text would help attract the reader's attention.
- In this paper, **we tackle a novel task of controlling keywords and the position of each keyword in text generation.**

## 2. Method

- We provide the model with target keywords, target relative positions of each keyword, and the target text length as control tokens.
  - **Keyword:** Keywords are the phrases that should be included in the generated text.
  - **Keyword position:** It is more practical to specify relative positions of each keyword such as "at the beginning" or "at the end" of the text. We express the position as the special token (e.g., 30-39% position from the beginning of the text => "[POS30-39]").
  - **Text length:** Length of the generated text is one of the important factors that users want to control when considering keyword positions. We express the length as the special token (e.g., 50-54 words => "[LEN50-54]").
- During training, **the model learns the correspondence between the control tokens and the target text.**
- During inference, **the model can generate text corresponding to the control tokens.**

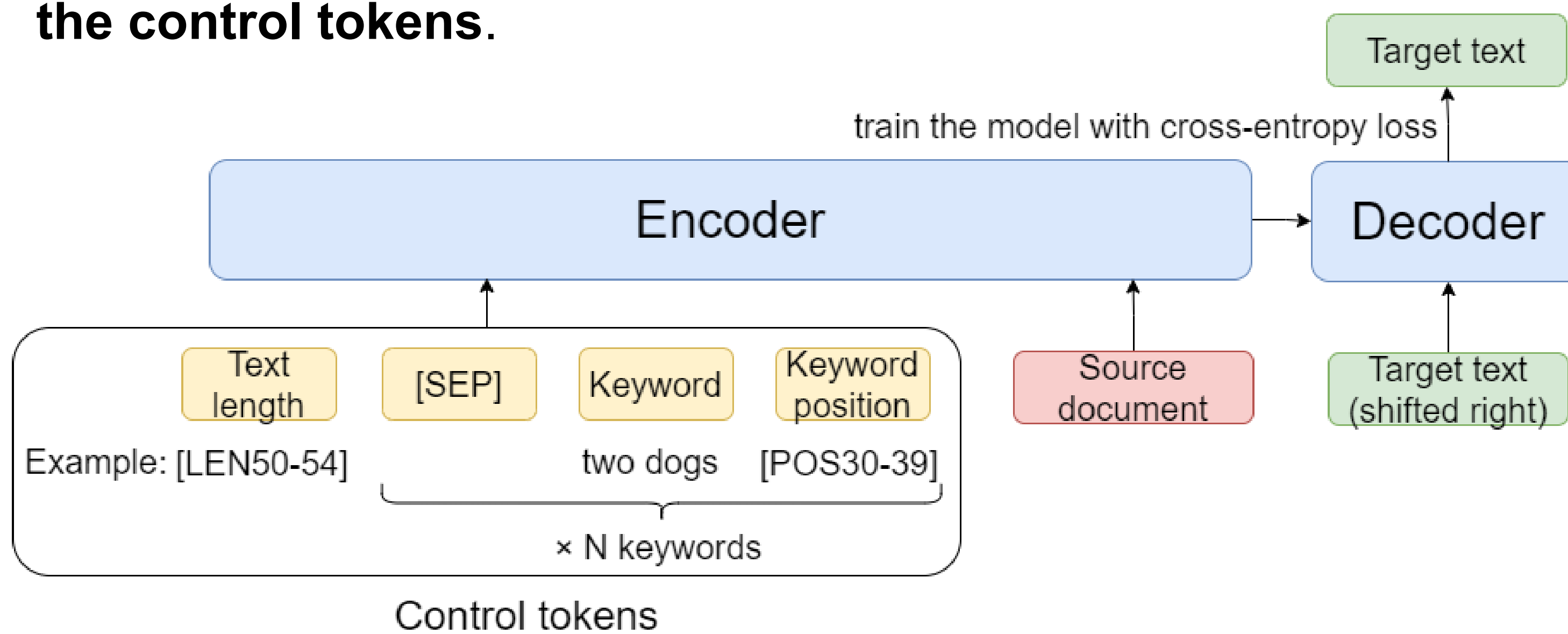


Fig1: The overview of the proposed method

Task	Summarization	Story Generation
Dataset	CNN/DM & XSum	ROGStories
Model	BART <sub>LARGE</sub>	GPT2

Table1: Experiment setting. We evaluate the proposed method by applying it to summarization and story generation tasks.

## 3. Experiment Results

### Evaluation1. keyword position control

- The proposed method using special tokens can generate text that includes the target keyword at the target position.
- Findings:
  - Length information improves the accuracy of position control.
  - Keyword position also improves the accuracy of keyword inclusion.
  - Control accuracy of story generation is lower than summarization.

Control	CNN/DM		XSum		ROCStories	
	Include	Pos	Include	Pos	Include	Pos
One keyword						
w/o Control	27.5	8.3	23.4	9.4	0.5	0.1
Keyword	71.3	18.7	86.4	28.7	53.0	14.3
+Len	72.7	20.4	85.8	30.8	50.9	13.5
+Pos	80.8	47.0	<b>92.1</b>	63.0	57.2	27.4
+Pos+Len	<b>85.8</b>	<b>48.8</b>	91.8	<b>64.1</b>	<b>58.8</b>	<b>29.1</b>
Two keywords						
Keyword	52.4	5.1	74.1	14.1	22.9	1.6
+Pos+Len	<b>75.9</b>	<b>28.6</b>	<b>85.9</b>	<b>46.4</b>	<b>31.1</b>	<b>7.9</b>

Table2: Evaluation of (i) accuracy of generating text **Including** the target keywords and (ii) accuracy of generating text in which the target keywords are placed in each target **Position**.

### Evaluation2. summary-content control

- The ROUGE score in summarization is improved by controlling keyword positions and text length.
- That finding indicates that such control makes it easier to generate text that is close to the user's intended content.

Control	CNN/DM			XSum		
	R1	R2	RL	R1	R2	RL
w/o Control	43.6	20.6	40.5	44.3	21.1	36.5
Keyword	44.4	21.4	41.3	45.9	22.7	38.4
+Len	45.7	22.1	42.5	47.0	23.5	39.3
+Pos	44.9	21.9	41.8	46.7	23.6	40.2
+Pos+Len	<b>46.4</b>	<b>22.8</b>	<b>43.2</b>	<b>47.8</b>	<b>24.5</b>	<b>41.2</b>

Table3: Summarization evaluation by ROUGE score. Target keywords are excluded from both the target and generated summaries.

## 4. Generated Examples

- By assigning different positions for the keywords, it was possible to generate several valid texts with different characteristics.
  - true miracle dog (0%) => a text that draws the reader's attention with an eye-catching keyword at the beginning of the text
  - true miracle dog (90%) => a narrative-style text that describes events in chronological order
- When multiple keywords are given, the order of the keywords can be adjusted by controlling the position of each keyword.

Keyword & Position	Generated text
true miracle dog (0%)	"She's a <b>true miracle dog</b> and she deserves a good life," foster mother says. Theia was apparently hit by a car and buried in a field. Four days later, she was found emaciated and dirt-covered by a farm worker. A fundraising page has raised more than \$10,000.
true miracle dog (40%)	A stray dog apparently hit by a car and buried in a field survives. The dog, named Theia, is "a <b>true miracle dog</b> ," her foster owner says. She suffered a dislocated jaw, leg injuries and a caved-in sinus cavity. A fundraising page has raised more than \$10,000.
true miracle dog (90%)	Stray dog apparently hit by a car and buried in a field survives. Four days later, she is found emaciated and dirt-covered on a farm. She has a dislocated jaw, leg injuries and a caved-in sinus cavity. A good Samaritan has set up a fundraising page for "the <b>true miracle dog</b> "
hit by (40%)	A stray dog in Washington State apparently died after being <b>hit by</b> a car. Four days later, she was found emaciated and dirt-covered in a
bully breed mix (60%)	field. Theia, a <b>bully breed mix</b> , has a dislocated jaw, leg injuries and a caved-in sinus cavity.
hit by (10%)	Theia, a <b>bully breed mix</b> , was apparently <b>hit by</b> a car and buried in a field. Four days later, she was found emaciated and dirt-covered by a
bully breed mix (0%)	farm worker. She suffered a dislocated jaw, leg injuries and a caved-in sinus cavity. A fundraising page has raised more than \$10,000.

Table4: Examples of generated texts from the CNN/DM dataset