Salient Information Prompting to Steer Content in Prompt-based Abstractive Summarization

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Motivation

Incorporating salient information has proven to be an effective approach to enhance text summarization performance.

Adapting this strategy to prompt-based summarization presents unique opportunities, particularly in guiding LLMs to generate summaries that fit different industrial use cases.

Our analysis provides valuable insights for applying these methods in real-world summarization applications, aiming to improve relevance and completeness in generated summaries.

SigExt Method

- We use a fine-tuned Longformer to extract keyphrases from source documents.
- The training labels are obtained by aligning the source document with reference summary.
- During inference, top-K deduplicated keyphrases are added in the prompt.

GP-SigExt:

- We pre-trained the Longformer on 7 datasets, and found the pre-trained keyphrase extractor has good generalization capability.

Figure 1: SigExt Keyphrase Extractor
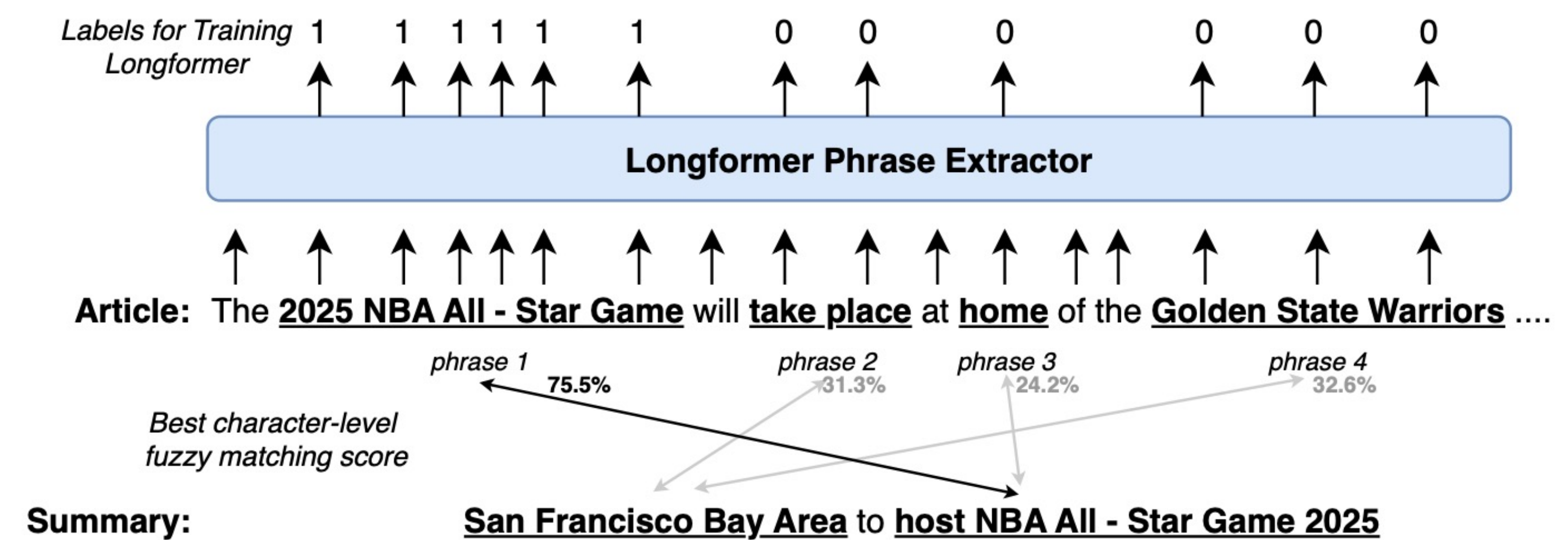
Prompt Example

Here is a news article: <text>
Please write a summary for the article in 2-3 sentences.
Consider include the following information: <keyphrases>.

Experiment Settings

- We evaluate SigExt on 4 summarization datasets spanning across formal/conversational long/short documents.
- We evaluate 3 LLMs -- Claude, Mistral and Falcon.
- We use ROUGE and AlignScore metrics, and ACU-base human evaluation.

Table 1: Human evaluation using atomic content units (ACUs).

	Raw ACU		Nomalized ACU	
	Claude	+SigExt	Claude	+SigExt
CNN	43.8%	**52.4%**	40.7%	**47.3%**
SAMSum	53.6%	**63.3%**	38.4%	**40.7%**

Table 2: Adding keyphrases extracted using SigExt into prompts can improve the alignment between generation and reference.

Method	SAMSum			CNN/DailyMail			ArXiv			MeetingBank			Avg.
	R1-f	RL-f	R1-r	R1-f	RL-f	R1-r	R1-f	RL-f	R1-r	R1-f	RL-f	R1-r	ΔR1-f
Claude-Ins.	40.0	30.3	52.8	38.1	23.9	41.9	44.4	23.1	53.2	32.2	21.8	43.4	
+2-stage	40.3	**31.0**	46.9	39.2	24.6	48.3	44.0	22.9	50.4	30.8	20.7	43.8	-0.1
+GP-SigExt	40.0	30.0	57.3	40.2	24.9	47.5	44.7	23.2	53.5	36.3	25.7	53.1	1.6
+SigExt	**41.6**	30.9	**59.5**	**42.0**	**26.6**	**48.6**	**45.2**	**23.5**	**53.7**	**42.3**	**31.9**	**60.5**	**4.1**

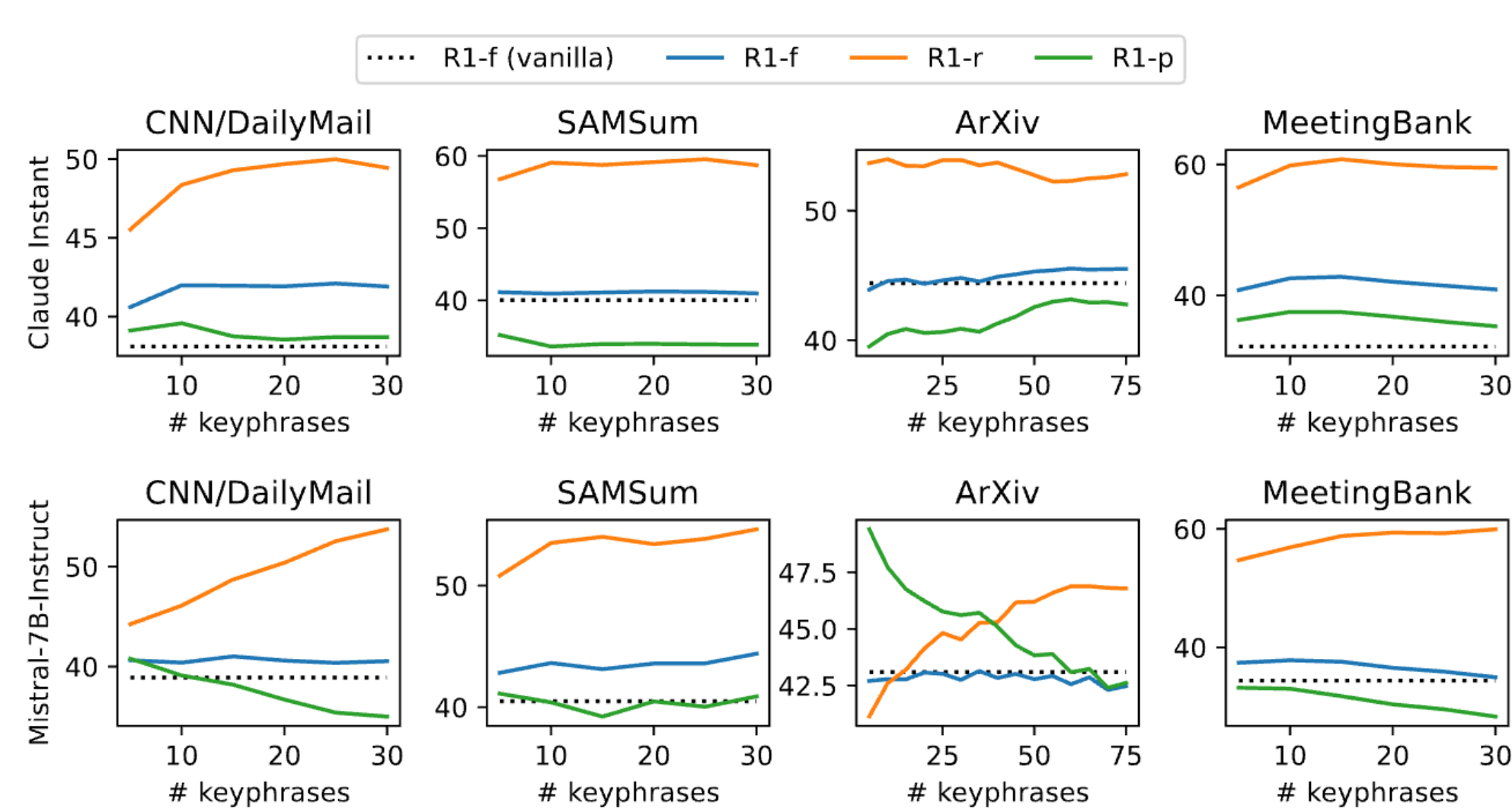### Figure 2: Precision-recall trade off by changing the number of keyphrases.

Table 3: Phrases are the optimal granularity for salient information compared to words or sentences.

Claude-Instant	R1-f	RL-f	R1-f	RL-f
	SAMSum		CNN	
+SigExt (word)	41.4	**30.9**	**42.0**	26.2
+SigExt (phrase)	**41.6**	**30.9**	**42.0**	**26.6**
+SigExt (sent)	39.1	29.7	40.3	25.7
	ArXiv		M.Bank	
+SigExt (word)	42.2	21.0	41.9	31.7
+SigExt (phrase)	**45.2**	23.5	**42.3**	**31.9**
+SigExt (sent)	44.8	**23.8**	36.2	25.8

Table 4: Using salient information in prompt may increase hallucination (evaluated by AlignScore).

	SamSum	CNN	ArXiv	M.Bank
Claude Ins.	85.8	83.8	53.7	73.1
+SigExt	**88.0**	82.3	**60.0**	**74.7**
Mistral-7B	**88.9**	**88.8**	**56.9**	**79.1**
+SigExt	84.7	87.0	49.5	77.1
Falcon-40B	**81.6**	67.7		
+SigExt	**81.6**	**75.0**		

Claude-Ins.	R1-f	Align.	R1-f	Align.
	SamSum		CNN	
+SigExt	41.6	**88.0**	42.0	**82.3**
+Oracle	**50.0**	86.3	**50.0**	78.8
	ArXiv		M.Bank	
+SigExt	45.2	**60.0**	42.3	**74.7**
+Oracle	**51.6**	45.9	**48.2**	56.7

Salient information may introduce hallucination

Document:
Jake: we don't have english today
Nadia: whooooah!
Vanessa: cool! you sure though?
Jake: Smith called in sick, they couldn't find a replacement, oh yeah

Keyphrases:
Vanessa; Smith called; Jake; replacement; english today

Summary (Mistral vanilla):
Jake announced that they don't have English class today due to Smith being sick and unable to find a replacement.

Summary (Mistral + SigExt):
Vanessa is excited that Jake is teaching English today instead of Smith, who called in sick and couldn't be replaced

Salient information improves completeness

Keyphrases:
toothpaste; suncream; patients; 404,500 prescriptions; NHS; indigestion pills costing £29million; NHS handed; £13million; spending millions; prescribed

Summary (Mistral vanilla):
The NHS is spending millions on prescriptions for suncream and other household essentials, according to a damning analysis. The figures come as the UK ranks below many European countries in health and wellness, and as the NHS faces a huge financial crisis.

Summary (Mistral + SigExt):
The NHS is spending millions of pounds on prescribing toothpaste and suncream to patients, ac- cording to a damning analysis. In 2014, the NHS handed out 404,500 prescriptions for suncream at a cost of £13million and 4.7million prescriptions for indigestion pills costing £29million.

[Code]

Contributions

1) We provide a comprehensive analysis on the impact of adding salient information in prompts for summarization
   Summary length: salient information can be used to control summary length.
   Reference alignment: salient information can improve reference alignment.
   Completeness: salient information can improve completeness.
   Hallucination: salient information may increase hallucination depending on the underlying LLM.

2) We present SigExt, a simple yet effective keyphrase extraction model using a finetuned Longformer. Once trained, it is LLM-agnostic, enabling performance boost for different LLMs by adding extracted keyphrases in prompts without requiring LLM finetuning.

3) We demonstrate that SigExt has cross-domain generalization capability through a general-purpose version (GP-SigExt) pretrained on 7 datasets.