Abstractive summarization on XSum

COMPARATIVE INSIGHTS INTO MODEL TRAINING STRATEGIES

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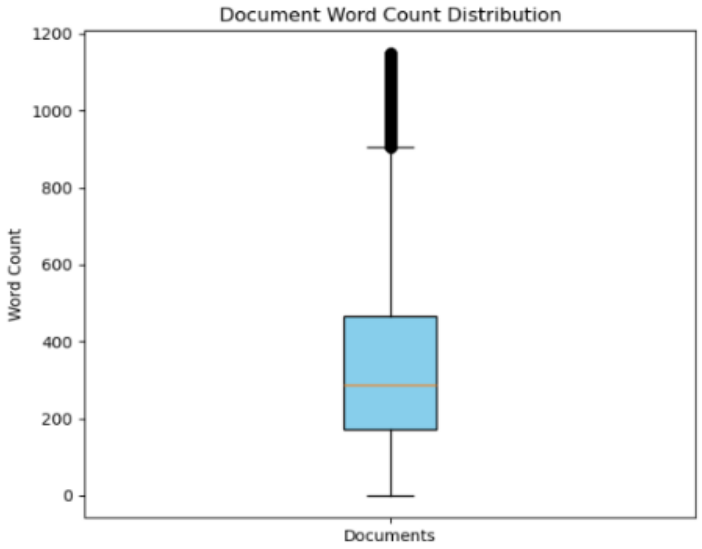
Presentation Outline

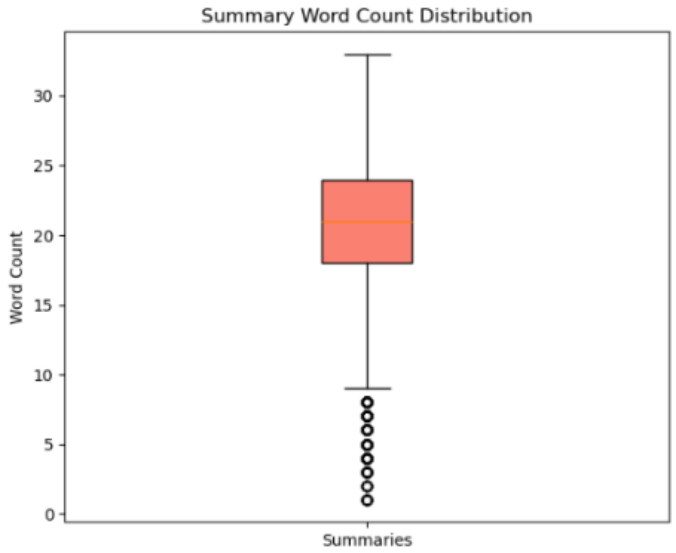
- **Goal**: Explore and benchmark multiple summarization methods.
- **Dataset**: XSum – single-sentence summaries of news articles with high compression and abstraction.
- **Baseline**: GRU with cross-attention.
- **Base Models**: T5-small, Flat-T5-base, Ollama models (LLaMA3:2B, Qwen3:8B).
- **Fine tuning, prompting and decoding strategies**
- **Evaluation**: ROUGE-1, ROUGE-2, ROUGE-L, BERTScore
- **Conclusions:** google-flan-T5 outperforms the other models in the benchmark

Project Motivation & Aim

Dataset: XSum (Extreme Summarization – BBC) (216,511 documents)
Split:
Train: 204,045
Val: 11,332
Test: 11,334
Objective: One-sentence, high-compression abstractive summaries
Outliers removal: Removed samples where summary ≥ document length

Dataset Statistics





Statistic	Value
Document length (words)	
Min	23
Max	4,189
Mean	431.07
Median	395
Summary length (words)	
Min	1
Max	94
Mean	23.13
Median	22

- 34 missing documents (0.016%)
- 223 duplicated documents (0.103%)
- Outlier detection and removal: analysis of the length ratio (summary/document) revealed some inadequate observations

Experimental Setup Overview

Model Name	R-1	R-2	R-L	METEOR	BERTScore
BART	0.27	0.07	0.21	0.57	0.22
FLAN-T5	0.35	0.13	0.27	**0.61**	**0.30**
LLaMA-3-8B	0.37	0.15	0.29	0.56	0.27
Gemma-7B	**0.39**	**0.18**	**0.32**	**0.61**	**0.30**

Shen et al., Evaluating LLMs and Pre-trained Models for Text Summarization Across Diverse Datasets, 2025.

- Models:
  - GRU Seq2Seq + attention
  - T5-small (0/1/few-shot, PEFT)
  - Flan-T5-base (prompt-tuned)
  - LLaMa 3.2:1b and Qwen3:8b
- Strategies:
  - Greedy, Top-k, Top-p, Beam
  - Prompting and fine-tuning
  - Parameter-efficient tuning

Evaluation metrics for Abstractive Summarization

ROUGE:

- *ROUGE-1*: Unigram (word-level) overlap
- *ROUGE-2*: Bigram overlap
- *ROUGE-L*: Longest common subsequence

BERTScore:

- Measures semantic similarity using contextual embeddings from pre-trained BERT model
- Captures paraphrasing and meaning beyond exact word match

Baseline:

Seq2Seq GRU + Attention

Encoder: single layer GRU

- Embedding dimension = 256
- Hidden layer dimension = 512
- Max input document length = 512 tokens

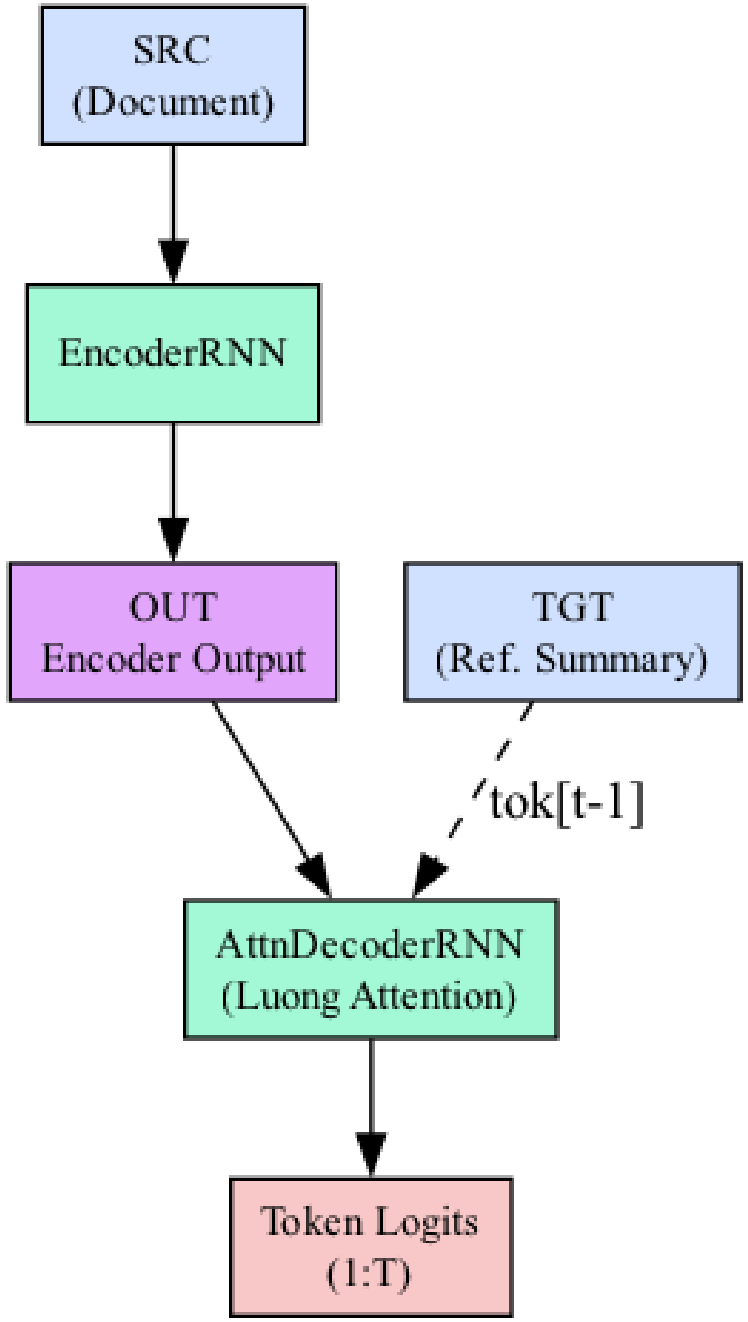
Decoder: single layer GRU + Luong attention

- Max output document length = 64 tokens

Training: teacher forcing, dropout, CE loss

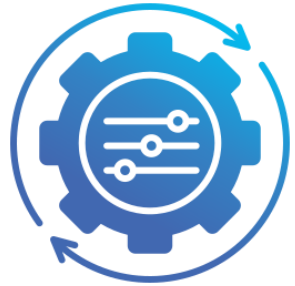
- Learning rate = 3e-4, Batch Size = 64
- Epochs: up to 15 with early stopping (patience = 2)

Tokenizer: T5-small



Fine tuning:

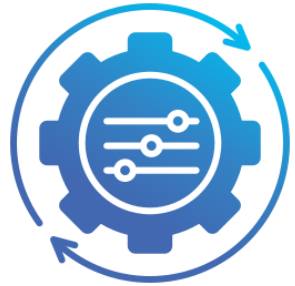
T5-small



Transformer encoder-decoder model	6 encoder + 6 decoder layers	~60M parameters
Constraints	Computational resources	Time
Proof-of-Concept study	Relative performances of FT strategies	10000/1000 samples (~5% train/validation)

Fine tuning:

T5-small



Full Fine Tuning

- 60M parameters
- Epochs = 10
- Learning rate = 3e-4

Prefix Tuning

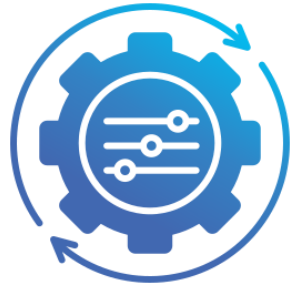
- 3,4M parameters (5%)
- Epochs = 5
- Learning rate = 3e-4
- Virtual tokens = 20
- Projection enabled = True

LORA

- 294K parameters (0,5%)
- Epochs = 5
- Learning rate = 3e-4
- Target modules = q, v
- Rank = 8
- Alpha = 32

Fine tuning:

T5-small



BitFit

- 512 parameters (0,000008%)
- Bias in relative position embeddings only
- Not implemented

Adapter Tuning

- 800K parameters (1,5%)
- Epochs = 5
- Learning rate = 3e-4
- Adapter dimension = 32

IA^3

- 43K parameters (0,1%)
- Epochs = 5
- Learning rate = 3e-4

Inference:

Decoding strategies

1

Greedy Decoding

2

Top-k

- top_k = 50
- do_sample = 1
- temperature = 1.0

3

Top-p

- top_p = 0.9;
- do_sample = 1
- temperature= 1.0

4

Beam Search

- num_beams = 4

Prompting with T5 Variants

- **T5-small:**
- Zero-shot, One-shot, Few-shot
- Limit: context window capacity
- **Flan-T5-base:**
- Better zero-shot generalization
- Natural instruction phrasing

Task: Summarize the input text. An example is provided below.

EXAMPLE:
Document: bluh bluhbluh bluhbluh bluh
Summary: bluh bluh

Input Text
Document: bluh bluhbluh bluhbluh bluh
Summary: [Fill the summary]

Local LLMs via Ollama

LLaMa 3.2:1b:

- Fast inference, short outputs

Qwen3:8b:

- Thinking model, more expressive, handles long inputs

	LLaMa3.2:1b	Qwen3:8b
ROUGE-1	0.231	0.232
ROUGE-2	0.047	0.053
ROUGE-L	0.156	0.165
ROUGE-LSUM	0.157	0.165
BERTScore	0.223	0.219

Prompt Design: Controlled length, trying prompt engineering to explore the optimal formulation by means of optimizing ROUGE-L

Evaluation Metrics

- Lexical:
- ROUGE-1, ROUGE-2, ROUGE-L
- Semantic:
- BERTScore (rescaled with baseline)

Results

Table 3: Model Performance on XSUM dataset

Model	ROUGE-1	ROUGE-2	ROUGE-L	BERTScore F1
google/flan-t5-base Zero-shot	0.338012	0.118883	0.266840	0.392381
google/flan-t5-base One-shot	0.337965	0.119797	0.267914	0.395298
google/flan-t5-base Few-shot	0.337772	0.119434	0.268080	0.394133
llama3.2:1b (Ollama)	0.231459	0.046637	0.156299	0.228511
Qwen3:8b (Ollama)	0.219483	0.056042	0.167671	0.219449
T5-small Zero Shot	0.171081	0.022468	0.120879	0.088924
T5-small finetuned Zero-shot	0.225432	0.053187	0.174207	0.147041
GRU_pred_greedy	0.189852	0.029122	0.139330	0.135189
GRU_pred_top_k	0.147645	0.013676	0.108129	0.049020
GRU_pred_top_p	0.137238	0.012181	0.102272	0.034133
GRU_pred_beam	0.189561	0.029555	0.139431	0.138498
T5-small_full_finetuned greedy	0.267096	0.068050	0.202963	0.274889
T5-small_full_finetuned top_k	0.235503	0.047575	0.173452	0.222997
T5-small_full_finetuned top_p	0.246502	0.053227	0.182996	0.244767
T5-small_full_finetuned beam	0.252725	0.064493	0.192806	0.253305
T5-small_ia3 greedy	0.005805	0.000791	0.004120	-4.759104
T5-small_ia3 top_k	0.088197	0.010947	0.063451	-2.215299
T5-small_ia3 top_p	0.032910	0.004364	0.023004	-3.990748
T5-small_ia3 beam	0.018928	0.002676	0.013046	-4.400565
T5-small_adapter greedy	0.182051	0.026008	0.127902	0.116483
T5-small_adapter top_k	0.180185	0.023186	0.122361	0.096015
T5-small_adapter top_p	0.184820	0.025604	0.126564	0.109817
T5-small_adapter beam	0.182140	0.026076	0.125912	0.111487
T5-small_lora greedy	0.201457	0.040417	0.153050	-0.414589
T5-small_lora top_k	0.192382	0.027305	0.142211	0.160064
T5-small_lora top_p	0.204280	0.031014	0.150524	0.182888
T5-small_lora beam	0.213166	0.043269	0.159973	0.149846
T5-small_prefix greedy	0.157360	0.024807	0.123434	-0.066709
T5-small_prefix top_k	0.127142	0.012411	0.096801	-0.088708
T5-small_prefix top_p	0.134681	0.013950	0.102743	-0.082276
T5-small_prefix beam	0.130399	0.024564	0.109902	-0.049091

Summary of Results

TOP PERFORMER: FLAN-T5 ZERO-SHOT (BERTSCORE F1 = 0.392)

T5-SMALL FINE-TUNED > PRETRAINED

GRU BASELINE: MODERATE, ACROSS DECODING METHODS

LOCAL LLMS: LLAMA3.2:1B QWEN3:8B STRONG IN SEMANTICS BUT WITH MODEST ROUGE

Explainability Analysis

- **Method:** Input × Gradient (IxG) with Inseq
- **Models:** FLAN-T5 (0, 1, few-shot)
- **Findings:**
- All focus on main input, not prompt
- Supports evaluation results (prompting style didn't affect quality)


Zero Shot

Source Saliency Heatmap

x: Generated tokens, y: Attributed tokens

	_A	_charity	_has	_said	_it	_is	_"	d	is	a	p	pointing	"	_that	_some	_prison	_leave	r	s	_are	_not	_getting	_the	_support
_Please	0.005	0.004	0.002	0.004	0.002	0.003	0.003	0.002	0.002	0.003	0.003	0.001	0.002	0.002	0.003	0.002	0.002	0.001	0.001	0.002	0.003	0.001	0.002	0.002
_write	0.003	0.002	0.002	0.003	0.001	0.002	0.002	0.001	0.001	0.002	0.002	0.001	0.001	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.002	0.001	0.001	0.001
_a	0.003	0.003	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
_short	0.007	0.004	0.003	0.004	0.002	0.003	0.004	0.002	0.002	0.003	0.002	0.001	0.002	0.003	0.004	0.002	0.002	0.001	0.002	0.002	0.003	0.002	0.003	0.002
_summary	0.011	0.008	0.006	0.008	0.005	0.006	0.008	0.004	0.003	0.005	0.005	0.003	0.004	0.005	0.007	0.004	0.004	0.002	0.003	0.003	0.005	0.003	0.006	0.005
_of	0.002	0.001	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.0	0.001	0.001	0.001	0.001	0.001	0.001
_the	0.001	0.002	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.001	0.001	0.001	0.0	0.001	0.001	0.001	0.001	0.001
_following	0.003	0.003	0.002	0.002	0.002	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.002	0.001	0.002	0.001
_article:	0.011	0.011	0.008	0.006	0.005	0.004	0.005	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.008	0.003	0.003	0.003	0.003	0.004	0.005	0.003	0.003	0.003
_Prison	0.015	0.021	0.016	0.006	0.006	0.004	0.005	0.002	0.003	0.003	0.003	0.004	0.003	0.003	0.007	0.008	0.008	0.004	0.004	0.003	0.003	0.002	0.002	0.003
_Link	0.023	0.032	0.029	0.01	0.011	0.005	0.007	0.004	0.004	0.005	0.004	0.009	0.004	0.004	0.006	0.004	0.003	0.002	0.003	0.003	0.005	0.003	0.003	0.003
_Cymru	0.013	0.02	0.016	0.01	0.008	0.004	0.005	0.004	0.004	0.004	0.003	0.005	0.003	0.003	0.005	0.01	0.003	0.003	0.003	0.003	0.004	0.003	0.002	0.002
_had	0.011	0.01	0.014	0.011	0.01	0.007	0.006	0.004	0.006	0.004	0.003	0.004	0.003	0.005	0.012	0.003	0.002	0.002	0.004	0.005	0.006	0.003	0.004	0.003
_1,099	0.008	0.006	0.009	0.007	0.005	0.004	0.003	0.002	0.003	0.002	0.002	0.002	0.002	0.003	0.008	0.002	0.001	0.001	0.003	0.003	0.003	0.002	0.002	0.002

_accommodation	0.003	0.002	0.002	0.002	0.003	0.004	0.005	0.005	0.003	0.003	0.004	0.001	0.003	0.002	0.002	0.003	0.002	0.002	0.003	0.004	0.005	0.003	0.003	0.004	0.003	0.002	0.004	0.004	0.008	0.002	0.001
_was	0.001	0.001	0.001	0.002	0.002	0.003	0.004	0.003	0.002	0.002	0.002	0.001	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
_"chronic".	0.005	0.006	0.003	0.012	0.008	0.01	0.02	0.033	0.014	0.019	0.018	0.007	0.008	0.006	0.006	0.003	0.003	0.003	0.003	0.004	0.004	0.004	0.003	0.003	0.003	0.004	0.004	0.003	0.004	0.005	0.005
_"There's	0.002	0.001	0.002	0.003	0.007	0.007	0.01	0.011	0.01	0.01	0.011	0.003	0.005	0.003	0.002	0.002	0.001	0.002	0.001	0.002	0.002	0.001	0.001	0.001	0.002	0.001	0.002	0.002	0.002	0.001	0.003
_a	0.001	0.002	0.001	0.002	0.003	0.003	0.005	0.006	0.009	0.007	0.011	0.003	0.003	0.004	0.003	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.001	0.001	0.001	0.001	0.001
_desperate	0.002	0.003	0.001	0.004	0.008	0.014	0.029	0.089	0.15	0.103	0.135	0.026	0.02	0.012	0.006	0.003	0.003	0.003	0.002	0.005	0.005	0.005	0.004	0.003	0.003	0.004	0.003	0.003	0.003	0.002	0.003
_need	0.002	0.001	0.001	0.002	0.006	0.008	0.011	0.013	0.015	0.017	0.014	0.005	0.007	0.004	0.002	0.001	0.001	0.001	0.001	0.003	0.002	0.002	0.002	0.002	0.002	0.003	0.002	0.002	0.001	0.001	0.001

Target Saliency Heatmap

x: Generated tokens, y: Attributed tokens

	_A	_charity	_has	_said	_it	_is	_"	d	is	a	p	pointing	"	_that	_some	_prison	_leave	r	s	_are	_not	_getting	_the	_support	_they	_need	_to	_find	_accommodation	.	</s>
<pad>	0.021	0.015	0.019	0.014	0.012	0.01	0.014	0.009	0.016	0.013	0.028	0.028	0.016	0.01	0.008	0.006	0.009	0.037	0.014	0.009	0.006	0.007	0.008	0.01	0.009	0.011	0.009	0.007	0.008	0.022	0.018
_A		0.035	0.024	0.008	0.009	0.008	0.006	0.005	0.008	0.008	0.004	0.008	0.006	0.005	0.002	0.002	0.001	0.002	0.002	0.003	0.001	0.003	0.002	0.001	0.002	0.002	0.002	0.001	0.001	0.006	0.005
_charity			0.07	0.013	0.027	0.016	0.017	0.012	0.016	0.019	0.01	0.02	0.01	0.011	0.007	0.003	0.008	0.009	0.007	0.005	0.003	0.005	0.005	0.004	0.012	0.014	0.008	0.004	0.003	0.011	0.008
_has				0.025	0.022	0.013	0.011	0.01	0.015	0.016	0.008	0.017	0.01	0.008	0.003	0.002	0.002	0.003	0.003	0.005	0.002	0.004	0.004	0.002	0.003	0.003	0.004	0.002	0.002	0.008	0.009
_said					0.047	0.024	0.028	0.014	0.027	0.027	0.015	0.028	0.021	0.014	0.008	0.004	0.003	0.004	0.005	0.009	0.004	0.008	0.009	0.003	0.005	0.004	0.004	0.002	0.004	0.014	0.014
_it						0.026	0.019	0.011	0.027	0.028	0.015	0.038	0.013	0.011	0.006	0.003	0.003	0.004	0.004	0.008	0.004	0.008	0.008	0.003	0.004	0.004	0.003	0.002	0.003	0.008	0.004
_is							0.018	0.009	0.02	0.021	0.013	0.026	0.02	0.013	0.005	0.003	0.003	0.003	0.003	0.009	0.004	0.005	0.005	0.002	0.003	0.003	0.004	0.002	0.003	0.008	0.003
_"								0.02	0.026	0.022	0.021	0.025	0.039	0.019	0.006	0.003	0.004	0.004	0.006	0.009	0.005	0.006	0.006	0.003	0.005	0.006	0.006	0.003	0.004	0.013	0.006
d									0.037	0.041	0.04	0.042	0.015	0.017	0.005	0.003	0.002	0.003	0.004	0.01	0.004	0.006	0.004	0.003	0.003	0.003	0.002	0.002	0.002	0.004	0.002
is										0.063	0.096	0.091	0.029	0.04	0.009	0.006	0.004	0.006	0.005	0.021	0.008	0.012	0.008	0.005	0.004	0.004	0.004	0.003	0.004	0.006	0.003
a											0.064	0.059	0.027	0.026	0.007	0.004	0.003	0.005	0.004	0.015	0.006	0.009	0.005	0.004	0.003	0.003	0.004	0.002	0.003	0.004	0.002
p												0.123	0.045	0.059	0.014	0.009	0.004	0.01	0.006	0.028	0.012	0.019	0.013	0.009	0.006	0.007	0.007	0.004	0.004	0.008	0.004
pointing													0.106	0.134	0.035	0.02	0.01	0.02	0.014	0.067	0.027	0.045	0.03	0.019	0.014	0.014	0.013	0.009	0.009	0.019	0.009
"														0.028	0.008	0.004	0.005	0.006	0.008	0.012	0.006	0.009	0.008	0.004	0.006	0.007	0.009	0.004	0.004	0.014	0.009
_that															0.014	0.012	0.007	0.016	0.016	0.021	0.012	0.019	0.017	0.006	0.009	0.008	0.008	0.004	0.004	0.011	0.006
_some																0.018	0.015	0.018	0.032	0.008	0.009	0.008	0.007	0.005	0.009	0.006	0.007	0.004	0.004	0.009	0.003
_prison																	0.096	0.081	0.032	0.005	0.007	0.004	0.007	0.006	0.006	0.006	0.008	0.004	0.013	0.011	0.003
_leave																		0.143	0.067	0.006	0.007	0.004	0.006	0.004	0.006	0.006	0.01	0.004	0.004	0.01	0.002
r																			0.075	0.007	0.004	0.003	0.004	0.003	0.004	0.006	0.005	0.003	0.003	0.005	0.002
s																				0.01	0.005	0.004	0.005	0.003	0.004	0.007	0.005	0.003	0.003	0.004	0.001
_are																					0.013	0.01	0.011	0.007	0.011	0.013	0.009	0.004	0.003	0.008	0.003
_not																						0.021	0.016	0.011	0.014	0.017	0.008	0.005	0.003	0.006	0.003
_getting																							0.024	0.019	0.026	0.023	0.014	0.012	0.005	0.007	0.002
_the																								0.016	0.023	0.016	0.018	0.013	0.005	0.006	0.002
_support																									0.066	0.059	0.036	0.03	0.011	0.013	0.004
_they																										0.029	0.016	0.01	0.008	0.011	0.003
_need																											0.029	0.02	0.012	0.012	0.003
_to																												0.016	0.01	0.009	0.003
_find																													0.027	0.013	0.004
_accommodation																														0.024	0.007
.																															0.041
</s>																															
probability	0.169	0.425	0.2	0.431	0.232	0.289	0.371	0.403	**0.671**	**0.599**	**0.976**	**0.985**	**0.976**	0.332	0.211	0.191	**0.632**	**0.999**	**0.999**	0.388	0.226	0.363	0.194	0.281	**0.949**	**0.842**	0.42	0.207	0.346	0.431	**1.0**

One Shot

Source Saliency Heatmap

x: Generated tokens, y: Attributed tokens

	_A	_charity	_has	_said	_it	_is	_"	d	is	a	p	pointing	"	_that	_some	_prisoners	_are	_not	_getting	_the	_support	_they	_need	_to	_find	_accommodation	.	</s>
_Task:	0.003	0.002	0.002	0.004	0.006	0.002	0.007	0.004	0.005	0.006	0.001	0.002	0.002	0.002	0.002	0.003	0.002	0.002	0.004	0.002	0.002	0.001	0.004	0.003	0.004	0.001	0.004	0.019
_Summarize	0.004	0.003	0.003	0.004	0.002	0.002	0.004	0.003	0.002	0.002	0.002	0.001	0.004	0.002	0.002	0.001	0.002	0.002	0.003	0.004	0.003	0.001	0.002	0.002	0.002	0.002	0.004	0.016
_the	0.001	0.001	0.001	0.001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.003
_input	0.003	0.002	0.001	0.002	0.001	0.001	0.002	0.001	0.001	0.001	0.001	0.001	0.002	0.001	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.008
_text.	0.004	0.002	0.002	0.003	0.002	0.002	0.002	0.002	0.001	0.002	0.001	0.001	0.002	0.002	0.002	0.001	0.001	0.001	0.001	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.008
_An	0.001	0.001	0.001	0.001	0.0	0.001	0.001	0.001	0.001	0.001	0.0	0.0	0.001	0.001	0.0	0.0	0.0	0.0	0.001	0.001	0.001	0.0	0.0	0.0	0.0	0.0	0.001	0.004
_example	0.002	0.001	0.001	0.002	0.001	0.001	0.003	0.002	0.001	0.002	0.002	0.001	0.002	0.001	0.001	0.001	0.001	0.001	0.002	0.003	0.002	0.001	0.001	0.001	0.001	0.001	0.002	0.012
_is	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.0	0.0	0.0	0.0	0.001	0.0	0.0	0.0	0.0	0.0	0.001	0.001	0.001	0.0	0.0	0.0	0.0	0.0	0.001	0.003
_provided	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.0	0.0	0.001	0.001	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.007
_below.	0.001	0.002	0.001	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.002	0.009
_###	0.002	0.002	0.001	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.03
_EXAMPLE:	0.002	0.002	0.002	0.002	0.001	0.001	0.002	0.002	0.001	0.002	0.001	0.001	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.014
_Document:	0.005	0.007	0.004	0.005	0.002	0.002	0.002	0.002	0.001	0.001	0.001	0.002	0.003	0.002	0.003	0.001	0.002	0.002	0.002	0.002	0.001	0.003	0.002	0.003	0.001	0.001	0.003	0.015
_The	0.0	0.0	0.001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.001
_full	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.001
_cost	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.001
_of	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
_damage	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.001
_in	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
_Newton	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
_Stewart,	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.001
_one	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
_of	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
_the	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.001
_areas	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

_Summary:	0.004	0.009	0.005	0.009	0.004	0.005	0.007	0.003	0.005	0.005	0.002	0.002	0.003	0.002	0.004	0.002	0.005	0.003	0.003	0.003	0.004	0.002	0.007	0.003	0.003	0.003	0.004	0.016
_Clean-up	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.0	0.001	0.001	0.0	0.0	0.0	0.0	0.001	0.001	0.001	0.001	0.0	0.0	0.0	0.001	0.001	0.0	0.0	0.001	0.0	0.002
_operations	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.001
_are	0.001	0.0	0.001	0.0	0.0	0.001	0.001	0.0	0.0	0.0	0.0	0.0	0.001	0.0	0.0	0.0	0.001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.001
_continuing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.001
_across	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.001
_the	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.001
_Scottish	0.001	0.001	0.001	0.001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.001
_Borders	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.001
_and	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.001
_Dumfries	0.0	0.001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.001
_and	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.001
_Galloway	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.001
_after	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.001	0.001
_flooding	0.0	0.001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.001
_caused	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.001
_by	0.0	0.001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.001
_Storm	0.0	0.001	0.0	0.001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.002
_Frank.	0.001	0.001	0.001	0.001	0.0	0.001	0.001	0.001	0.001	0.001	0.001	0.0	0.001	0.001	0.001	0.001	0.001	0.0	0.001	0.001	0.001	0.001	0.001	0.0	0.001	0.0	0.001	0.007
_###	0.004	0.003	0.002	0.003	0.002	0.002	0.002	0.002	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.001	0.002	0.001	0.002	0.002	0.001	0.001	0.001	0.001	0.002	0.001	0.003	0.037
_INPUT	0.005	0.003	0.002	0.002	0.003	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.003	0.001	0.002	0.001	0.002	0.002	0.002	0.001	0.001	0.001	0.002	0.001	0.003	0.017
_TEXT:	0.007	0.008	0.005	0.006	0.004	0.003	0.003	0.004	0.002	0.003	0.003	0.002	0.006	0.005	0.004	0.002	0.003	0.004	0.004	0.005	0.004	0.003	0.003	0.003	0.003	0.002	0.006	0.02
_Document:	0.015	0.015	0.015	0.013	0.007	0.007	0.006	0.005	0.004	0.005	0.004	0.005	0.009	0.005	0.01	0.005	0.006	0.006	0.006	0.005	0.006	0.006	0.005	0.005	0.004	0.003	0.007	0.025
_Prison	0.014	0.021	0.016	0.006	0.007	0.004	0.004	0.002	0.004	0.003	0.003	0.005	0.003	0.003	0.007	0.01	0.004	0.004	0.003	0.003	0.003	0.003	0.003	0.004	0.004	0.002	0.005	0.005
_Link	0.022	0.03	0.028	0.009	0.01	0.006	0.006	0.004	0.005	0.005	0.005	0.01	0.004	0.004	0.006	0.006	0.003	0.005	0.003	0.004	0.004	0.003	0.003	0.003	0.004	0.002	0.006	0.005
_Cymru	0.013	0.02	0.015	0.01	0.007	0.004	0.004	0.004	0.004	0.004	0.003	0.006	0.003	0.003	0.005	0.012	0.003	0.004	0.003	0.003	0.003	0.002	0.002	0.003	0.003	0.002	0.005	0.005
_had	0.011	0.01	0.011	0.008	0.009	0.007	0.006	0.004	0.005	0.004	0.003	0.004	0.004	0.004	0.009	0.003	0.005	0.005	0.004	0.004	0.003	0.003	0.003	0.003	0.002	0.002	0.004	0.003
_1,099	0.008	0.006	0.007	0.005	0.005	0.004	0.003	0.002	0.003	0.002	0.002	0.002	0.002	0.002	0.007	0.002	0.003	0.003	0.002	0.003	0.002	0.002	0.002	0.002	0.002	0.001	0.002	0.002

Conclusions

Best Generalization: FLAN-T5 zero-shot

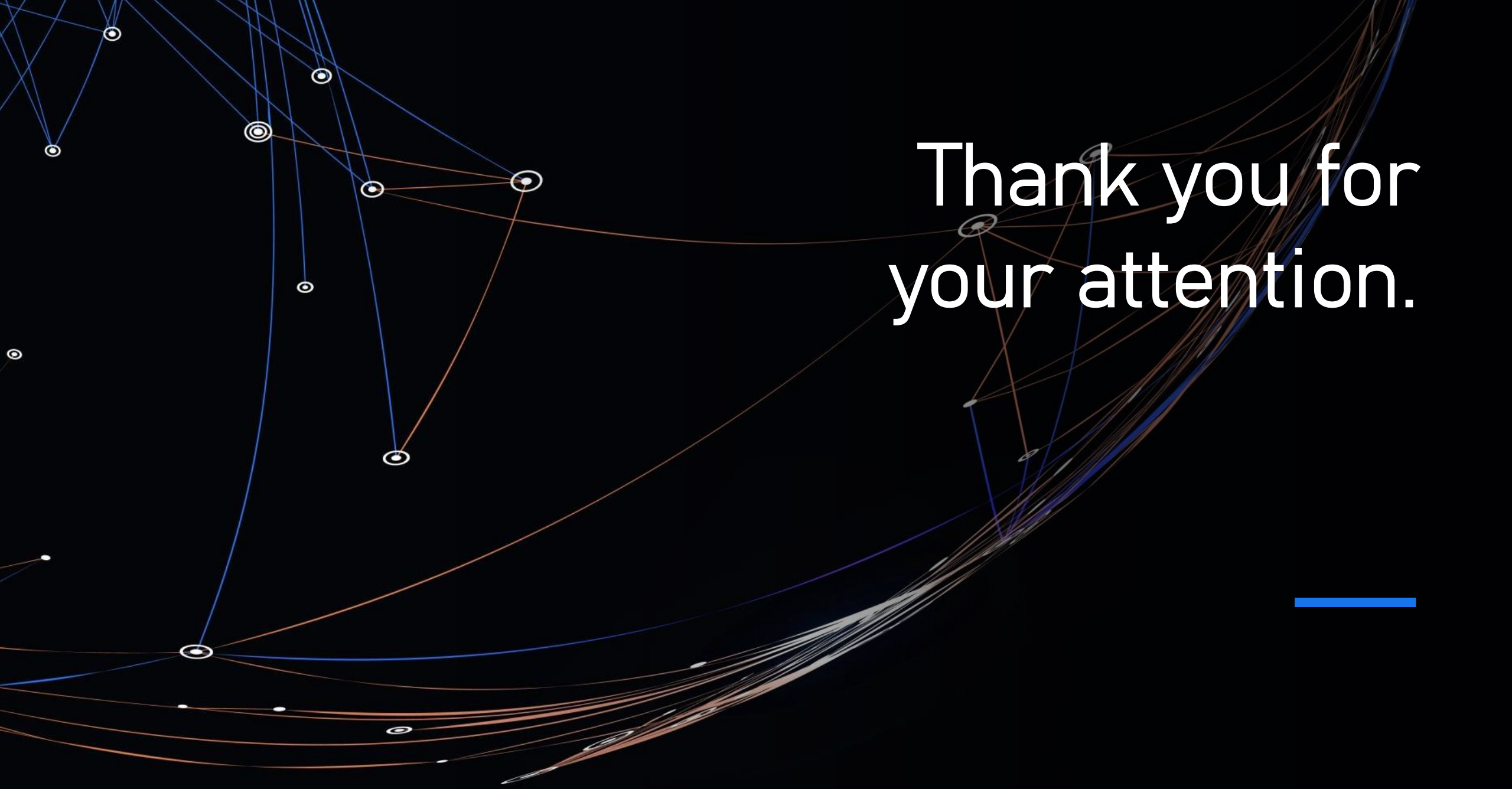
PEFT (e.g., LoRA) improved T5-small

Qwen: High-quality outputs despite lower ROUGE

GRU: Valid but outperformed by transformers

Future Perspectives

- Full-dataset fine-tuning
- Hyperparameter tuning
- New evaluation metrics
- Divide the documents by topic (and explore topic-specific performance)


Thank you for
your attention.