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SmartSumm: Abstractive Summarization with Transformers and TextRank

1. Introduction

Automatic text summarization plays a critical role in today's information-saturated world. With the exponential growth of digital content, especially in news, education, and healthcare, the ability to generate concise and meaningful summaries is essential. Traditional extractive approaches like TextRank rely on sentence ranking to build summaries, often leading to disjointed outputs. In contrast, modern transformer-based models such as BART and T5 are capable of abstractive summarization — generating entirely new phrases that better capture meaning.

This research investigates whether transformer-based models outperform traditional extractive techniques for summarizing news articles, using the XSum dataset as a benchmark.

2. Related Work

Text summarization has long been an area of interest in NLP. Traditional methods like TextRank (Mihalcea & Tarau, 2004) use graph-based ranking for sentence extraction. Abstractive methods, especially with the advent of transformers, have shown promise. BART (Lewis et al., 2020) and T5 (Raffel et al., 2020) are pre-trained language models fine-tuned on summarization tasks. Several benchmarks like CNN/DailyMail and XSum are used for evaluation, with BART often outperforming traditional baselines in fluency and coherence.

3. Methodology

This study compares three models:

- **BART (facebook/bart-large-xsum)**
- **T5 (t5-base)**
- **TextRank (implemented via the Sumy library)**

We use a sample of 50 documents from the XSum dataset, which consists of BBC news articles and one-sentence reference summaries. Each document is

summarized using all three models.

We evaluate performance using ROUGE-1, ROUGE-2, and ROUGE-L scores. Additionally, we analyze qualitative differences via case study examples.

4. Experiments

4.1 Quantitative Results

Model	ROUGE-1	ROUGE-2	ROUGE-L
BART	0.4821	0.2541	0.4075
T5	0.1975	0.0366	0.1425
TextRank	0.1633	0.0276	0.1107

BART outperforms T5 and TextRank across all metrics, indicating its superiority in capturing both n-gram overlap and sentence structure.

4.2 Qualitative Examples

Document 1
The ex-Reading defender denied fraudulent trading charges relating to the Sodje Sports Foundation...
Reference:
Former Premier League footballer Sam Sodje has appeared in court alongside three brothers accused of charity fraud.

- **BART:** ***Former Premier League footballer Sam Sodje has pleaded not guilty to fraud and money laundering charges.***
- **T5:** ***ex-Reading defender denied fraudulent trading charges...***
- **TextRank:** ***The ex-Reading defender denied fraudulent trading charges... appearing at the Old Bailey...***

Document 2
Voges was forced to retire hurt on 86 after suffering the injury while batting during the County Championship...
Reference:
Middlesex batsman Adam Voges will be out until August after suffering a torn calf muscle in his right leg.

- **BART:** ***Middlesex batsman Adam Voges has been ruled out for the rest of the season with a knee injury.***
- **T5:** ***middlesex hope to have Voges back for their T20 Blast game...***
- **TextRank:** ***Voges was forced to retire hurt on 86... Voges retired from international cricket...***

Document 3
Seven photographs taken in the Norfolk countryside by photographer Josh Olins will appear in the June edition...
Reference:
The Duchess of Cambridge will feature on the cover of British Vogue to mark the magazine's centenary.

- **BART:** ***The Duchess of Cambridge is to feature on the cover of British Vogue for the first time...***
- **T5:** ***seven photographs taken by photographer Josh Olins... the duchess is to visit the exhibition...***
- **TextRank:** ***Nicholas Cullinan said: "Josh has captured the duchess exactly as she is...***

5. Discussion:

BART produced summaries closest to the reference in both content and form. It captures abstract meanings and paraphrases effectively. T5 struggled with factual consistency and often omitted critical information. TextRank, while coherent, often failed to condense content and relied on copying multiple sentences.

Limitations include using a small sample size and lack of fine-tuning for BART/T5. Future work could involve training domain-specific summarizers or integrating factual consistency checks.

6. Conclusion:

This study demonstrates that BART significantly outperforms both T5 and TextRank in abstractive summarization on the XSum dataset. Transformer models are more adept at generating concise and meaningful summaries, though care must be taken regarding their factual accuracy. With more data and fine-tuning, performance can be further improved.