NLP Assignment – CSL7340

REVIEW OF SOME OF THE EVOLUTIONS IN ABSTRACTIVE SUMMARIZATION

AND

IMPLEMENTING- ENHANCEMENT TO AN EXISTING METHOD

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Introduction:

Summarization can be done by tow means, Abstractive and Extractive. Extractive text summarization work on the principle of extracting the most relevant sentences or paragraphs in the source document. Abstractive summarization, on the other hand, tries to rewrite and reformulate text from the original document, which is more similar to how a human does summarization

We now focus on evolution of Abstractive Summarization along with some of the research papers. Infact, we have discussed 3 research papers and implement a project combining two other research papers.

Typically, neural networks are used to predict the next word in a sequence based upon the previously seen words. But recently it has been used in end-to-end fashion, often to provide input for other non-neural network-based translation systems to increase their performance.

Some of the sequential development includes

- Translating sequences of words between languages called Neural Machine Translation (NMT). They applied an LSTM-based encoder-decoder model that could handle varying length input and output sequences by encoding one sequence at a time into a fixed size hidden vector which later was decoded sequentially.
- Encoder-Decoder models for machine translation with the attention mechanism, which was shown to increase translation performance on long sequences.
- Attention mechanism was later adapted with Encoder-Decoder in the context of abstractive summarization.
- Implementation of convolutional encoder and implementing beam search in the decoder. This model was applied on single sentence summaries with good results.
- Another attention mechanism in the context of text summarization was done in 2016, With only small changes to the original encoder-decoder architecture, they were able to reach state of the art performance on abstractive text summarization tasks. For evaluation, they utilized the ROUGE metric.
- Two of the most common issues with abstractive summarization that could lead to unnaturally sounding summaries are words in the input that are not part of the vocabulary, so called out of vocabulary words, as well as unnecessary word repetition in the generated output sequence. In the context of multi-sentence summarization using the seq2seq model, to counter the out of vocabulary problem, pointer-generator network was implemented.

- In response to the word repetition in the output, coverage mechanism was used in seq-to-seq models, resulted in good results. This result is measured using ROUGE, METEOR and duplicate N-GRAMS.
- Transformer model was introduced, In the approach, the RNN parts are removed entirely making the model rely only on attention to learn the dependencies between input and output sequences. Implementing Transformer for translation resulted in state-of-the-art performance.
- Methods like Bi-Directional Selective Encoding, Global Encoding and other techniques came in picture for seq-to-seq models. Bi-Directional Selective Encoding has showed some improvement in the performance.
- The transformer model has since been used in language modeling for a variety of tasks achieving state of the art results. A recent implementation of the Transformer for text summarization was done by Liu et al. in 2018. They evaluate the Transformer, a seq2seq model, and a modified version of the Transformer that only uses the decoder part. The evaluation showed that both of the Transformer variants outperformed the RNN-based seq2seq model in terms of ROUGE score and when using five human evaluators.
- Then there have been implementations of couple of post summarization evaluators like FactCCX and there are some implementations to correct the corrupted data through summarizations.

We have taken 3 research papers, one from each category

- Pointer Generator with Transformer- which already is based on attention by architecture with coverage
- Factual Error Correction of Abstractive Summarization
- BiSET - Bi-directional Selective Encoding with Template for Abstractive Summarization

Then implemented by blending two papers

- Abstractive Text Summarization with Transfer Learning

  (Exploring the Limits of Transfer Learning with a Unified Text-to-Text Transformer), JMLR 21, Google July,2020

- Bottom-Up Abstractive Summarization, EMNLP 2018, Harvard Oct,2018

Transformers And Pointer-Generator Networks for Abstractive Summarization.

We have seen earlier the evolution of this good research in introduction, we now see actually how it works, why it works, benefits and scope.

- While running the plain RNN and Transformers for abstractive summarization we end up in too much repetition of words, fail to handle out-of-vocabulary (OOV) words and we will get factual inaccuracies
- Implementing RNN with pointer-generator networks, coverage vectors, and n-gram blocking helped in resolving issues in seq-to-seq summarizer similarly adopting this with Transformer could also help in resolving these issues.
- Infact, Transformers have outperformed, seq-to-sequence encoder-decoder models for translation and summarization. Adopting with these techniques would result in state-of-the-art results.

ARCHITECTURE:

- N-GRAM BLOCKING: Used to reduce repetition. During beam search, eliminates words that create an n-gram that already exists in the summary.

$$covloss_t = \sum_i \min(a_i^t, c_i^t)$$

- COVERAGE LOSS: Also used to reduce repetition. coverage loss penalizes the model for repeatedly paying attention to the same words.

Use to define the coverage loss, which gets added to final loss of the transformer with a weight of λ.

$$loss_t = -\log P(w_t^*) + \lambda \sum_i \min(a_i^t, c_i^t)$$

- POINTER GENERATOR NETWORK ON A TRANSFORMER:

Pointer-generator network allows the transformer to point to and copy words from the source text, as well as generate new words and phrases. With a learned probability pgen, this model will generate a new word as normal from P vocab, the softmax of the transformer output. Otherwise, the pointer-generator will utilize its joint attention to selectively point to and then copy words directly from the source text. Their model calculates pgen using the RNN decoder's hidden state.

$$p_{gen} = \sigma\left(w_h^\top h_t^* + w_s^\top s_t + w_x^\top x_t + b_{ptr}\right)$$

We mapped st, h ∗ t and xt from their RNN model to analogous values in our transformer model. We generated an attention distribution over the source, at, by summing across the multiple heads of the encoder-decoder multi-head attention in the last decoder layer.

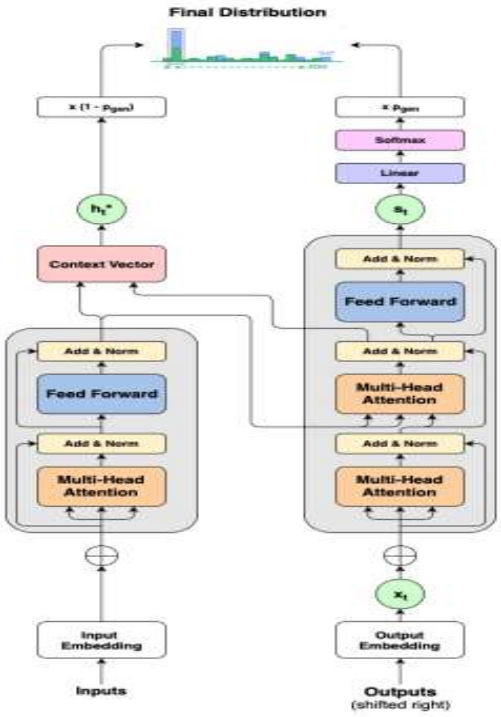
The context vector h ∗ t was taken as the average across the source dimension of the final encoder layer's output, weighted by the source attention distribution at. We took the output of the final decoder layer as analogous to the RNN-decoder hidden state, st. This is used to reduce factual inaccuracies and OOV mishandling.

Results obtained by the author

Table 1: Results

Method	R-1	R-2	R-L
Vanilla RNN (See et al., 2017)	30.49	11.17	28.08
Pointer-Generator (See et al., 2017)	36.44	15.66	33.42
Pointer-Generator + Coverage (See et al., 2017)	**39.53**	17.28	**36.38**
Transformer (Sanjabi)	27.4	-	-
Transformer Baseline	20.23	3.45	13.43
Transformer + Pointer-Generator	22.10	4.03	14.66
Transformer + Pointer-Generator + Coverage	22.93	4.08	15.08
Transformer + Pointer-Generator + N-Gram Blocking (2-gram)	25.31	4.16	15.99

Architecture of Transformer with Pointer Generator



EXAMPLE:

Human Summary: oleg kalashnikov died of gunshot wounds , ukraine 's interior ministry said . he was a party of regions deputy in ukraine 's previous parliament . kalashnikov was ally of deposed ukrainian president viktor yanukovych .
Baseline Transformer Summary: viktor [UNK] was found dead at the vladimir putin 's death . he was found dead in his remained remained remained remained remained ...
Pointer-Generator Summary: russian oleg oleg oleg oleg sergei yanukovych was found dead . viktor was found dead at home in kiev in kiev . viktor yanukovych was found dead in the the kremlin has been been been been since .
Pointer-Generator + Coverage Summary: ukrainian prime minister yanukovych was found dead in his home in kiev . ukrainian leader was found dead in his home in kiev , in kiev .
Pointer-Generator + 2-Gram Summary: oleg viktor yanukovych was found dead in his home in kiev . he is of the ukraine of ukraine 's parliament . the former ukrainian president vladimir putin says he was " " the communist party ".

LIMITATIONS:

- Still factual in accuracies generated by the model are not rectified.
- Author now face repetition of phrases and ideas rather than repetition of individual words.

Factual Error Correction for Abstractive Summarization Models.

Meng Cao Yue Dong Jiapeng Wu Jackie Chi Kit Cheung School of Computer Science, McGill University, Montreal, QC, Canada MILA, Montreal, QC, Canada, ***EMNLP,2020***

Neural abstractive summarization systems have achieved promising progress, thanks to the availability of large-scale datasets and models pre-trained with self-supervised methods. However, ensuring the factual consistency of the generated summaries for abstractive summarization systems is a challenge. This paper proposes a post-editing corrector module to address this issue by identifying and correcting factual errors in generated summaries.

ARCHITECTURE

- Author's uses BART model, BART is a sequence-to-sequence auto-regressive transformer model that is pretrained as a denoising auto-encoder.

- Factual consistency checking, the model needs to classify each original input summary as consistent or inconsistent with respect to the source text. It is thus a binary classification task for which we report accuracy, as well as precision, recall, and F1.
- Error correction, the model must correct inconsistencies in the original summary (in any) with respect to the source text

Specifically, given an input sentence that is corrupted by text infilling, token deletion as well as other text transformations, BART is trained to output the original sentence. This pretraining task is similar to our summary correction task in which we can regard the corrupted or generated summary as the noisy input and in this case the noise is the inconsistent content in the summary.

This model takes a draft summary that is generated by an abstractive summarization model and produces a corrected final summary, conditioned on the source document. In addition, our trained corrector can be used as an evaluation model for factual consistency of abstractive summaries, with the assumption that a generated summary is inconsistent if our corrector decides to make edits. To teach the model to correct errors, we train it with artificial data that has factual errors introduced using heuristics. The empirical results based on automatic and human evaluations indicate that our model not only corrects factual errors in summaries, it is also a reliable factuality evaluation model.

Data is corrupted using by changing Entity, Number, Date and Pronoun errors in CNN/DailyMail (train data set) and **K2019 (test data set)**. For error correction, among the 5780 corrupted summaries in the test set, 62.13% are corrected by the model to exactly match the reference summary. For the 5710 clean summaries, the model made changes to 26.27% of them, which results in 73.73% correction accuracy on clean summaries. These results show that the model is able to correct majority of the test samples even under our strict evaluation measure.

Example:

Source:
Jerusalem (CNN)The flame of remembrance burns in Jerusalem, and a song of memory haunts Valerie Braham as it never has before. This year, Israel's Memorial Day commemoration is for bereaved family members such as Braham. "Now I truly understand everyone who has lost a loved one," Braham said. (...)
Original: **France's** memorial day commemoration is for bereaved family members as braham. *(inconsistent)*
After Correction: **Israel's** memorial day commemoration is for bereaved family members as braham. *(consistent)*

Table 1: An example of an inconsistent system-generated summary and the output summary from our correction model. In this case, "France" is successfully corrected as "Israel".

Overall Performance of the implementation

	Overall Acc.	Consistency checking		
		Prec.	Recall	F1
Corrupted	84.38%	0.79	0.95	0.86
Clean		0.93	0.74	0.82

Table 3: Performance of our model on consistency checking on our test set of artificial corruptions. Corrupted and clean refer to the subsets of the test set that were artificially perturbed or not perturbed, respectively.

Though the performance of this method is better than other methods proposed earlier (FACTCCX, etc), this also corrects some of the factual numbers by mistake up to 26%.

BiSET - Bi-directional Selective Encoding with Template for Abstractive Summarization

To overcome the impediments of limited and sometimes noisy training data, we need to better use of the available training data by applying filters during summarization. Bi-directional Selective Encoding with Template (BiSET) model is used for abstractive sentence summarization.

- This model involves a novel bi-directional selective layer with two gates to mutually select key information from an article and its template to assist with summary generation.
- Using the templates selected by our approach as the final summaries, this can achieve superior performance to some baseline models, demonstrating the effect of our templates. This may also indicate the availability of many quality templates in the corpus.
- BiSET, outperforms all the state-of-the-art models significantly.

To evaluate the importance of the bi-directional selective layer and the two gates, the results show that, while both of the gates are necessary, the template-to-article (T2A) gate tends to be more important than the article-to-template (A2T) gate.

This Model is designed for both accuracy and efficiency. Due to the parallelizable nature of CNN, the Fast Rerank module only takes about 30 minutes for training and 3 seconds for inference on the whole test set. The BiSET model takes about 8 hours for training (GPU:GTX 1080), 6 times faster than R3Sum.

Working of this method involves 3 steps and are

- Retrieve: For each source article, Retrieve aims to return a few candidate templates from the training corpus.
- Fast Rerank: This module quickly identifies a best template from the candidates.
- BiSET: Mutually selects important information from the source article and the template to generate an enhanced article representation for summarization

Fast Rerank:

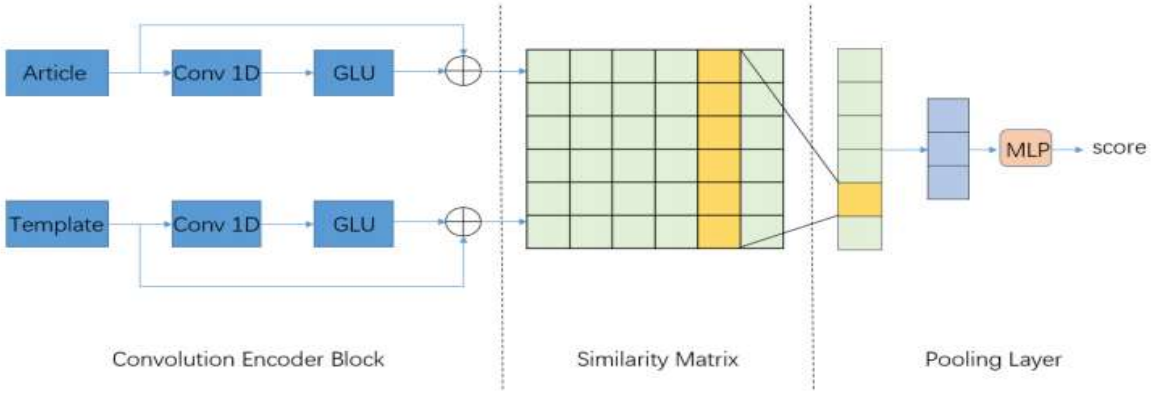


Figure 1: Overview of the Fast Rerank Module.

- The retrieval process is essentially based on superficial word matching and cannot measure the deep semantic relationship between two articles. Therefore, the Fast Rerank module is developed to identify a best template from the candidates based on their deep semantic relevance with the source article.
- The Fast Rerank module consists of
    - *Convolution Encoder Block:* Author implement a new convolution encoder block which includes a word embedding layer, a 1-D convolution followed by a non-linearity function, and residual connections. Gated linear unit (GLU) as our activation function to control the proportion of information to pass through.
    - *Similarity Matrix:* The above encoder block generates a high-level representation for each source article/candidate template. Then, a similarity matrix S ∈ R m×n is calculated for a given article representation, S ∈ R m×d , and a template representation, T ∈ R n×d.

$$s_{ij} = f(\mathbf{S}_i, \mathbf{T}_j)$$

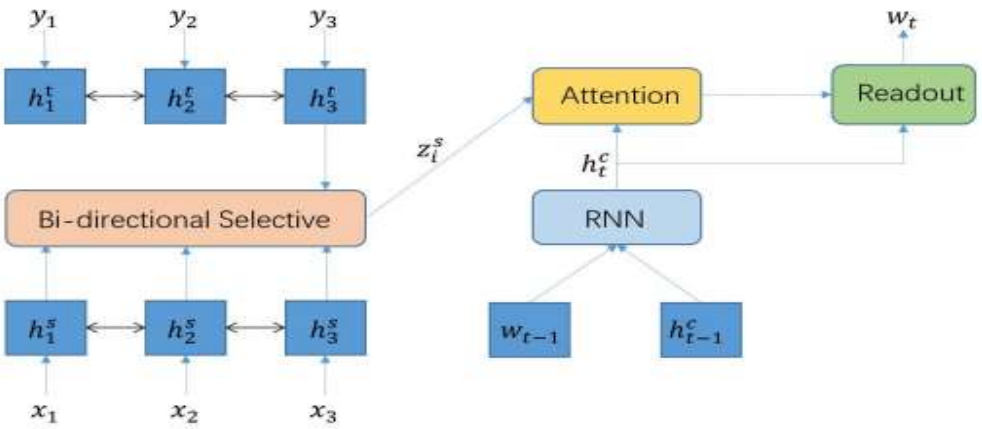
$$f(x, y) = exp(-\|x - y\|^2)$$

- *Pooling Layer:* This layer will filter out unnecessary information in the matrix S. Finally, we apply a two-layer feed-forward network to output a similarity score for the source article and the candidate template.

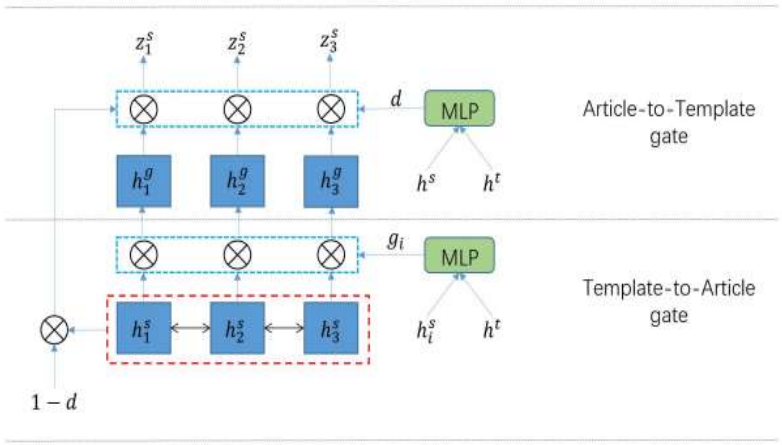
BiSET:

The core idea behind BiSET is to involve templates to assist with article representation and summary generation. BiSET contains two selective gates: Template-to-Article (T2A) gate and Article-toTemplate (A2T) gate. The role of T2A is to use a template to filter the source article representation. The purpose of A2T is to control the proportion of h g in the final article representation.

BISET ARCHITECTURE



BIDIRECTIONAL SELECTIVE LAYER



Role of the bi-directional selective layer and its two gates:

Firstly, we removed the selective layer and replaced it with the direct concatenation of an article with its template representation. As the results show in Table 5, the model performs even worse than some ordinary sequence-to-sequence models in Table 3. The reason might be that templates would overwhelm the original article representations and become noise after concatenation. Then, we removed the Template-to-Article (T2A) gate, and as a result the model shows a great decline in performance, indicating the importance of templates in article representations. Finally, when we removed the Article-to-Template (A2T) gate, whose role is to control the weight of T2A in article representations, only a small performance decline is observed. This may suggest that the T2A gate alone can already capture most of the important article information, while A2T plays some supplemental role.

RESULT

Model	ROUGE-1	ROUGE-2	ROUGE-L
Concatenation	32.26	15.30	30.19
BiSET without T2A	34.51	16.55	31.17
BiSET without A2T	39.02	19.21	36.02
BiSET(full)	39.11	19.78	36.87

Table 5: ROUGE F1 scores of ablated models.

DATASETS AND IMPLEMENTATION:

The dataset used for evaluation is Annotated English Gigaword, a parallel corpus formed by pairing the first sentence of an article with its headline. During training, both the Fast Rerank and BiSET modules have a batch size of 64 with the Adam optimizer. We also apply grad clipping with a range of [-5,5]. The differences of the two modules in settings are listed below.

Fast Rerank: The size of word embeddings is set to 300, the convolution encoder block number to 1, and the kernel size of CNN to 3. The weights are shared between the article and template encoders. The k of k-max pooling is set to 10. L2 weight decay with $\lambda = 3\times10-6$ is performed over all trainable variables. The initial learning rate is 0.001 and multiplied by 0.1 every 10K steps. Dropout between layers is applied.

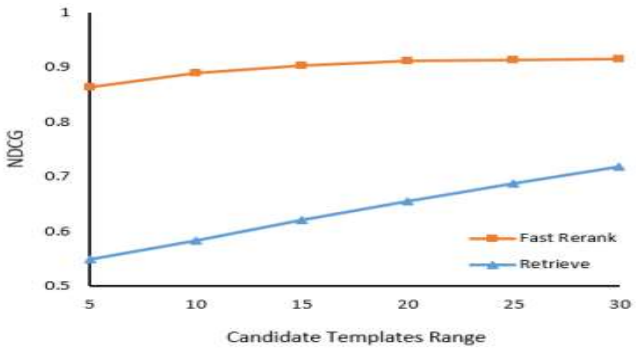


Figure 4: Quality of rankings given by Fast Rerank.

BiSET: A two-layer BiLSTM is used as the encoder, and another two-layer LSTM as the decoder. The sizes of word embeddings and LSTM hidden states are both set to 500. Apply dropout in the LSTM stack with a rate of 0.3. The learning rate is set to 0.001 for the first 50K steps and halved every 10K steps. Beam search with size 5 is applied to search for optimal answers.

Type	ROUGE-1	ROUGE-2	ROUGE-L
Random	2.58	0.00	2.48
Retrieve-top	23.46	7.67	20.94
5-Optimal	32.69	11.74	28.71
10-Optimal	35.90	13.32	31.42
15-Optimal	37.82	16.79	34.08
20-Optimal	38.92	17.72	34.94
30-Optimal	40.49	19.01	36.10

Table 1: Performance of different types of templates.

Retrieve: The Retrieve module is intended to narrow down the search range for a best template. We evaluated this module by considering three types of templates:

(a) Random means a randomly selected summary from the training corpus;

(b) Retrieve-top is the highest-ranked summary by Retrieve;

(c) N-Optimal means among the N top search results, the template is specified as the summary with largest ROUGE score with gold summary.

As the results show in Table 1, randomly selected templates are totally irrelevant and unhelpful. When they are replaced by the Retrieve-top templates, the results improve apparently, demonstrating the relatedness of top-ranked summaries to gold summaries. When the N-Optimal templates are used, N grows.

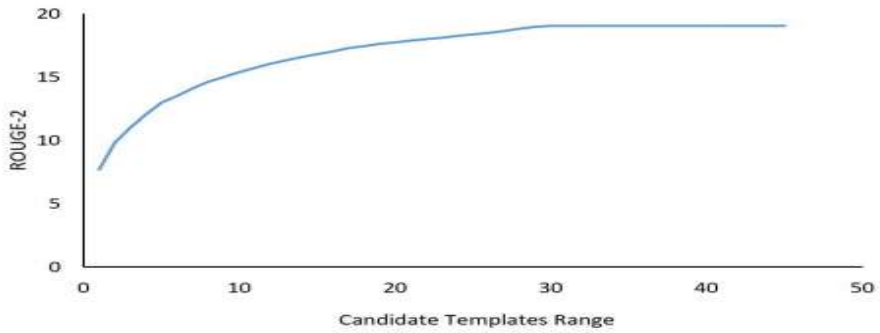


Figure 3: Quality of candidate templates under different ranges.

Overall, BiSET model significantly outperforms all the baseline models and sets a **new state of the art for abstractive sentence summarization**.

Model	ROUGE-1	ROUGE-2	ROUGE-L
ABS‡ (Rush et al., 2015)	29.55	11.32	26.42
ABS+‡ (Rush et al., 2015)	29.78	11.89	26.97
RAS-Elman‡ (Chopra et al., 2016)	33.78	15.97	31.15
Featseq2seq‡ (Nallapati et al., 2016)	32.67	15.59	30.64
Open-NMT‡ (Klein et al., 2017)	34.07	16.35	31.78
SEASS‡ (Zhou et al., 2017)	36.15	17.54	33.63
S2S+CGU‡ (Lin et al., 2018)	36.30	18.00	33.80
FTSum‡ (Cao et al., 2018b)	37.27	17.65	34.24
R^3Sum‡ (Cao et al., 2018a)	37.04	19.03	34.46
BiSET	**39.11**	**19.78**	**36.87**

Table 3: Performance of all the models, where results marked with ‡ are taken from the corresponding papers.

The performance of BISET model improves constantly with the improvement of template quality.

Template Type	ROUGE-1	ROUGE-2	ROUGE-L
Random	33.85	15.83	31.14
5-rerank	37.69	18.62	34.38
10-rerank	38.34	19.35	34.97
20-rerank	38.89	19.64	36.67
30-rerank	39.11	19.78	36.87

Table 4: Performance of BiSET with different types of templates, where **Random** means randomly-selected templates, and **N-rerank** denotes the best templates re-ranked by Fast Rerank under range N.

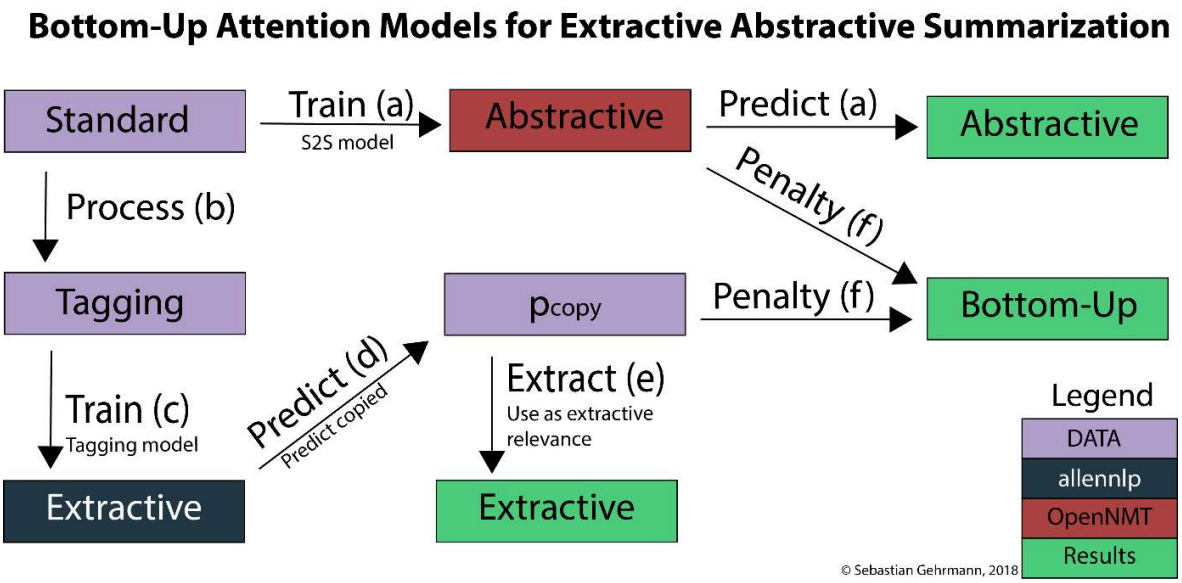
BLENDING TWO BEST TECHNIQUES IN SEARCH OF BETTER RESULTS:

a. Abstractive Text Summarization with Transfer Learning
   (Exploring the Limits of Transfer Learning with a Unified Text-to-Text Transformer), JMLR 21, Google July,2020
b. Bottom-Up Abstractive Summarization, EMNLP 2018, Harvard Oct,2018

Abstractive Text Summarization using Transfer Learning: Abstractive text summarization has achieved success in switching from linear models via sparse and handcrafted features to nonlinear neural network models via dense inputs. This success comes from the application of deep learning models on natural language processing tasks where these models are capable of modeling intricate patterns in data without handcrafted features. Research from Telekom Innovation Laboratories [5], also proves that e Transfer Learning-based model achieved considerable improvement for abstractive text summarization over seq-to-seq models.

Bottom-up Summarization: Author used this selector as a bottom-up attention step to constrain the model to likely phrases. We show that this approach improves the ability to compress text, while still generating fluent summaries. This two-step process is both simpler and higher performing than other end-to end content selection models, leading to significant improvements on ROUGE.

The script can also be used to evaluate against the gold targets as created by the preprocessing by setting tgt. You can switch between extraction of sentences and phrases by using the style parameter. If you want additional indicators in between extracted phrases, use divider. The threshold for the extraction of phrases can be set by threshold.



Implementation:

We will see the performance of the Transformer with Transfer Learning first and then result of this would be fed into the Bottom-up Summarization for betterment.

Abstraction using Transformer Architecture:

Model: T5-Base Transformer pretrained

Optimizer: AdamW

Attention: Multiheaded- default

Learning Rate: e-3

Tokenizer: T5TokenizerFast

Dataset: We have used the Kaggle News Summary Data set for this research

Train Test Split: 90:10➔3396:440

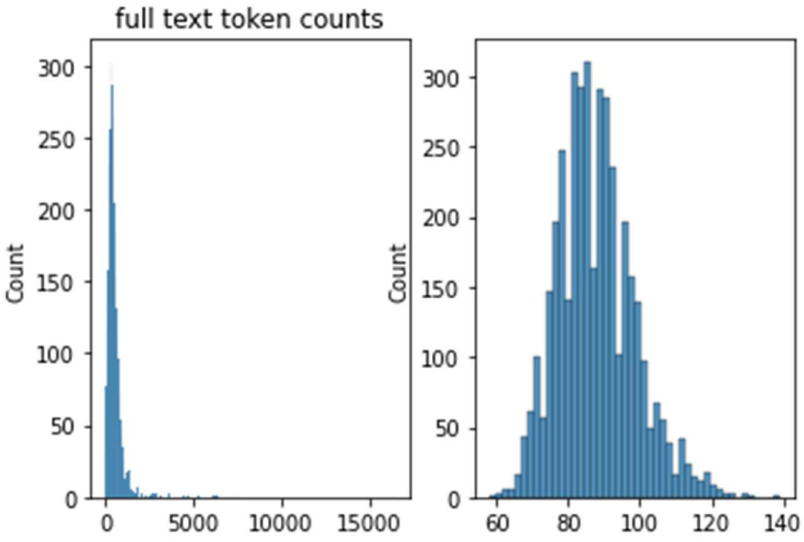
Number of beams=1

Repetition Penalty: 2.5

Length penalty: 1

Verification Methods: Rogue Score

Attention mask to be used if the input sequence length is smaller than the max input sequence length in the current batch. It's the mask that we typically use for attention when a batch has varying length sentences.



Source Text Tokens Vs golden data Tokens

Model Parameters:

```
  | Name  | Type                 | Params
----------------------------------------------------
0 | model | T5ForConditionalGeneration | 222 M
----------------------------------------------------
222 M     Trainable params
0         Non-trainable params
222 M     Total params
891.614   Total estimated model params size (MB)
```

Result:

Result of the T5-base trained with the specified parameters are outperforming the results of the other methods, only worry is the data using which these results are derived are different need to run all of them with this newly proposed architecture and test.

Result of Bi-Selective Layer

Interaction method	ROUGE-1	ROUGE-2	ROUGE-L
Concatenation	32.26	15.30	30.19
Concate+multi self-att	33.15	15.93	31.21
DCN Attention	31.53	13.77	27.96
Bi-selective layer	39.11	19.78	36.87

Table 2: Results of different interaction approaches.

Result of Transformer with Point Generator, Coverage and n-Gram

Table 1: Results

Method	R-1	R-2	R-L
Vanilla RNN (See et al., 2017)	30.49	11.17	28.08
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Transformer + Pointer-Generator + N-Gram Blocking (2-gram)	25.31	4.16	15.99

Result on testing in the given news dataset

	Rouge-1			Rogue-2			Rogue-L		
T5-Base	F1	P	R	F1	P	R	F1	P	R
News Dataset	45.89	46.12	46.1	24.47	24.6	24.58	42.89	43.12	43.14

With assumption, that all the datasets remain with same nature results of this t5-base is outperforming the results of other methods. 45.89 is assumed to be one of the best results.

We have displayed least 5 scores, top 5 scores and 5 results of implementing this in amazon food review data

5 summarizations having least score:

Example 1	
rouge-1	{'f': 0.13592232534640414, 'p': 0.1111111111111111, 'r': 0.175}
rouge-2	{'f': 0.019801975457309242, 'p': 0.016129032258064516, 'r': 0.02564102564102564}
rouge-l	{'f': 0.0898876357278124, 'p': 0.07272727272727272, 'r': 0.11764705882352941}
text	Ever since its inception, Chiranjeevi troops have been waiting with bated breath to see the megastar making a comeback after a 10-year hiatus. Khaidi No 150 Cast: Chiranjeevi, Kajal Aggarwal, Tarun Arora and Brahmanandam Khaidi No 150 Director: VV VinayakKhaidi No 150 Rating: (3/5)Despite the blockbuster film that Kaththi was, Chiranjeevi has to be appreciated for choosing a remake as his comeback to films. Being at the helm of a remake is like attracting the last nail to one's own coffin as it invariably compels the audience to get into unnecessary comparisons. ALSO READ: Chiranjeevi on Khaidi No 150- I'm not nervous, but curiousALSO READ: Chiranjeevi on Naga Babu-RGV fight- I was hurt, but I didn't reactHowever, director VV Vinayak makes no mistake with Khaidi No 150. Barring a few scenes and songs, the film is a frame-by-frame rendition of the Tamil version.Much like its original, the film introduces Kaththi Seenu (Chiranjeevi), an inmate of a Kolkata prison, trying to escape from the cops. The director shows Seenu's prison number (150), pauses for a few seconds, and then reveals Megastar's face. This customary introduction scene sees a chest-thumping reception from the Telugu circuit; after all, they've been dying to see him for years.As for the plot, a petty thief Kaththi Seenu discovers his badly wounded doppelganger Shankar (also Chiranjeevi) and decides to disguise himself as the latter to escape from the Kolkata police.When the plot slowly unfolds, Seenu gets to know about Shankar, a hydrologist, who is fighting against a corporate tycoon Aggarwal (Tarun Arora). Aggarwal attempts to draw groundwater from the Neeruru village to further his business. He's also to be blamed for the many farmer suicides.After learning the actual reason behind farmer suicides, Seenu and Aggarwal face off in this commercial yet socially relevant entertainer.Apart from the mass moments in the film, what deserves a special mention is Murugadoss's writing. While rampant issues like farmer suicides barely make for front page news, films like Khaidi No 150 or Kaththi pokes the audience's conscience. Films in this genre cater to a larger sect if it manages to deliver entertainment with a veiled social angle in it. In that sense, Khaidi No 150 is a win-win, even if the film is only about half as riveting compared to Chiranjeevi's Rudraveena (1988). There's a superb portion where the director criticises the mainstream media for having failed to address issues like farmer suicide. Some of the scenes have been purposely written to target the masses.Be it dialogue delivery or dancing, Chiranjeevi gives a stellar performance in dual roles. What's amusing about the actor is that even at 61, his age is hardly visible on screen. His son and actor Ram Charan, who has also produced the film, has a guest appearance in the song Ammadu Let's Do Kummudu. It goes without saying that Chiranjeevi's forte is dance and he's flexible with moves even after all these years. Ace comedians Ali and Brahmanandam provide the comic relief in Khaidi No 150.Samantha played the female lead in the Tamil version, while Kajal Aggarwal plays the role in Telugu. Though it's almost necessary to have a heroine on board, we wonder why both the actors were cast in their respective projects.One of the highlights of both the films is the coin fight scene. But the only difference is that while Vijay beat 80 goons to a pulp in Kaththi, the number is multiplied by 10 in its Telugu version. Because, Chiranjeevi. Neil Nitin Mukesh gave a commendable performance as the antagonist in Kaththi. Unfortunately, Tarun Arora is too funny to be taken seriously here.Khaidi No 150 has music by rockstar Devi Sri Prasad. The makers have retained a lot from the Tamil version. Khaidi No 150 would have been far better had Anirudh Ravichander composed the score for the Telugu version as well. Inevitably, most of the background score brings back memories of Kaththi. Though most of the songs spoil the mood of the film, they are worth your time just because you get to watch Chiranjeevi dance.

summary	'Khaidi No 150', which released on Wednesday, "is more about Chiranjeevi and his return than about the story or cinema," wrote The New Indian Express. "The story has it's heart in the right place," wrote Times of India while India Today wrote, "Films like Khaidi No 150... poke the audience's conscience." It was rated 2.5/5 (NIE), 3/5 (TOI, India Today). Nnnnnnnn
pred	Actor Chiranjeevi's upcoming film 'Khaidi No 150' is a frame-by-frame rendition of the original. The film introduces Kaththi Seenu, an inmate of a Kolkata prison, trying to escape from the cops. The film also stars Kajal Aggarwal and Tarun Arora.
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text	Prime Minister Narendra Modi showed his might in his own parliamentary constituency of Varanasi, which will vote on March 8, yesterday with a massive roadshow. However, questions were raised over the show of strength with the Congress moving the Election Commission.The Congress complained that Modi's roadshow was held without necessary permission from the Varanasi administration. The Election Commission has even sought a reply from the District Magistrate of Varanasi regarding Modi's roadshow.The BJP today said that yesterday's event was not an official roadshow of PM Modi, who was on his way to Kashi Vishwanath temple and Kaal Bhairav temple while people just joined him on his way.
summary	Quoting writer Mark Twain in Varanasi on Sunday, Prime Minister Narendra Modi said, "'Our Benaras is older than history, older than tradition." "It is my dream to bring the whole country forward, including Purvanchal. If we do so, it won't take long for us to progress," Modi added. The leader also reiterated his slogan of 'Sabka saath, sabka vikas'.
pred	The Election Commission has sought a reply from the District Magistrate of Varanasi regarding Prime Minister Narendra Modi's roadshow. The Congress complained that Modi's roadshow was held without necessary permission from the Varanasi administration. The Election Commission has also sought a reply from the District Magistrate regarding Modi's roadshow.
Example 3	
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text	It took him five years and lot of courage to openly speak about his battle with drug addiction. After making a promising start in Bollywood, Prateik Babbar vanished from the limelight for a good five years. His absence might not have caught anybody's attention, but his return has grabbed many eyeballs. And why not? For the first time, the 30-year-old actor has openly spoken about his battle with substance abuse. When many actors shy away from talking about their issues, Prateik has come out in the open, talking about his his long battle with addiction. In an interview to Mumbai Mirror, the actor talked about addiction, recovery and his career. This is what he said. On addiction He has come to terms with complications of his life and has fought the demons of substance abuse. It was last year when he first talked about his drug addiction, and in the last one year, he has been a "work in progress". "Addiction is not a moral failing, it does not make you a bad person even if you have made a poor choice. People still think I got hooked because it was 'cool' for a celebrity to indulge in recreational drugs. But for me, it was more of an escape from reality. My childhood was complicated and there were a lot of questions I didn't have answers to so I looked elsewhere for solace," said Prateik. On acceptanceIt took him a while to understand that he was an addict, and he needed to get out of it as soon as possible. "Acceptance and speaking up can help change the face of addiction. It educates those who are ailing and tells others that the stereotype of people suffering is the exception rather than the rule. Acceptance is one of the first steps to recovery," added the actor. On coming outPrateik came out in open about his addiction as he didn't want to keep his fans in the dark. He wanted them to be aware of the dark truth of his life. "I'm a fighter and criticism is not an option for me. Yes, one is entitled to his/her opinion and it's human to be judgmental but everyone deserves a

	second chance. The idea is to move on. I want to create awareness by showcasing the boy uninterrupted so the world doesn't get to see just one side of the story," said the 30-year-old actor. On recoveryIt has taken him a few years to get back to his normal life and he says that with each passing day, he is making an effort to better his life. He said, "I'm still on the road to recovery but I'm proud to have turned over a new leaf. Substance abuse is like a bad marriage, even after you quit, it haunts you for a while till people start noticing the turnaround. I'm answerable to only my conscience. And yes, people take me more seriously now that I'm no longer the hippie rave but someone committed to fitness, auditions and family."On his careerHe began his career with the 2008 film Jaane Tu... Ya Jaane Na, and went onto bag a few promising roles in the subsequent years. However, it's been almost five years since Prateik has been seen on the big screen. But the actor is all set to bounce back. "I'm looking for quality work and am not embarrassed to go out and ask for it. I'm also doing a lot of theatre with Jeff Goldberg because I believe it polishes your acting skills," he added.
summary	Actor Prateik Babbar, while speaking about dealing with drug addiction, said substance abuse is like a bad marriage. "[E]ven after you quit, it haunts you for a while till people start noticing the turnaround," he added. Prateik further said, "Addiction is not a moral failing, it doesn't make you a bad person even if you have made a poor choice".
pred	Actor Prateik Babbar has revealed that he was addicted to drugs for five years. "People still think I got hooked because it was 'cool' for a celebrity to indulge in recreational drugs, but for me, it was more of an escape from reality," said the 30-year-old actor. He added, "It took him a while to understand that he was an addict and needed to get out of it as soon as possible."
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text	Whether it is a supernova or an asteroid impact, should a cosmic calamity strike, it seems there will be at least one form of life left: a tubby, microscopic animal with the appearance of a crumpled hoover bag.The creatures, known as tardigrades, are staggeringly hardy animals, a millimetre or less in size, with species living in wet conditions that range from mountain tops to chilly ocean waters to moss and lichen on land.?They can survive incredible conditions ? we are talking close to absolute zero, the vacuum of space, exposure to radiation that would kill us, and these things just walk away from it like nothing happened,? said David Sloan, an astrophysicist from the University of Oxford.Now new research by Sloan and colleagues has shown that the creatures would survive any cosmic disaster that might conceivably be thrown at Earth ? a discovery that could have implications elsewhere in the solar system, and beyond. ?There are quite a lot of stars like our sun out there, and about 20% of these stars have an Earth-like planet around them,? said Sloan. ?What you then want to ask is if life started on one of these planets, what are the odds that it is still around??Writing in the journal Scientific Reports, the researchers describe how they probed the conundrum by exploring the likelihood of a variety of catastrophes serious enough to wipe out tardigrades on an Earth-like planet, including a nearby supernova, a burst of gamma-rays, and an impact by a large asteroid powerful enough to cause the oceans to boil away. But the team found that the chances of such events were so remote as to be extremely unlikely ? there was little chance of a supernova occurring close enough to an Earth-like planet to kill off the creatures, and it would take an impact from an asteroid or dwarf planet near the mass of Vesta for the oceans to boil. ?There are about 17 [asteroids] this big in our solar system, but they are all on sufficient orbits that they will never intersect with us,? said Sloan. The upshot, he said, was that it was very unlikely any cosmic event would be so catastrophic as to sterilise an Earth-like planet where life, of the sort we know, had got going. ?Because [tardigrades] are so hardy it means that events that we are worried about as human beings, and rightly so, certainly wouldn?t concern you if you just considered all life,? said Sloan. Matthew Cobb, professor of zoology at the University of Manchester, who was not involved in the study said the findings were reassuring for the future of life on Earth.?It suggests that the complete eradication of life on Earth is extremely unlikely until we get to the point that the sun enlarges and all the oceans boil away,? he said. ?Many organisms, in particular animals and bacteria, live in the deep ocean, which the authors show would be unaffected by any conceivable

	cosmic cataclysm.?Mark Blaxter, professor of evolutionary genomics at the University of Edinburgh, agreed, adding that there are other organisms have a similar survival strategy to tardigrades. What?s more, he said, there are also organisms that live very deep underground in hot water within continental and under-sea-floor rocks. ?Sterilising the planet would have to deal with these too,? he noted. He also stressed that even tardigrades are not invincible. ?[Land-based] tardigrades stay alive in extreme conditions by drying out completely. So if there was no water left ? there would be no ?live? tardigrades, just dried up ones,? said Blaxter. ?And if there was some water left so that the tardigrades could re-animate, if there was no food left they eat algae and fungi - they too would be dead in a couple of weeks.?Cobb, too, noted that even if the tardigrades were the only survivors, they would face a struggle. ?For the tardigrades to inherit the Earth, whatever catastrophe swept over the planet would have to return to normal-ish conditions within a matter of decades at most, or it really could be curtains,? he said.
summary	The most resilient form of life on Earth, tardigrade, also known as water bear, will survive until the Sun dies, as per an Oxford University research. The eight-legged micro-animal can survive for 30 years without food or water, and endure temperature extremes from -270ÂºC to 150ÂºC. Further, tardigrades can withstand catastrophic events like large asteroid impacts, supernovae, and gamma-ray bursts.
pred	Scientists from the University of Oxford have found that tardigrades, a micro-organism with the appearance of a crumpled hoover bag, would survive any cosmic disaster that might strike Earth. The creatures can survive extreme conditions, including exposure to radiation that would kill them, and they just walk away from it like nothing happened, scientists said.
Example 5	
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text	A woman from Chembur had gone to buy vegetables outside her building for a few minutes in April. When she returned she saw that her house was ransacked and her gold jewellery missing. Another woman in Shivaji Nagar went to her daughter?s school to pick her up and when she returned she found her house robbed.For the past one year, the Mumbai and Thane police were getting regular complaints of house break-ins within minutes by unknown thieves.After months of investigation and rounding up several history sheeters, the Tilak Nagar police found just one witness. He told the police that the robbers were dressed in jeans and t-shirts and had sunglasses. He said that the men got out of a Swift Desire and seemed to be guests at a house. However they left the building within 10 minutes, said the witness. ?We only knew that they drove a Swift Desire,? said inspector Santosh Kamble from Tilak Nagar police station.A team of three officers were then assigned to investigate the series of house break-ins. The officers, including PI Avinash Pore and PSI Amol Ambawane, found that the car that the robbers used had a number plate of a bullet bike from Meerut. The informers told the officers that this gang was from Meerut and travelled by car from Uttar Pradesh to Mumbai. The gang would stop on the way to Mumbai and break in to houses. ?The Meerut gang only chose two- or three-storey houses for a quick escape,? said Shahaji Umap, deputy commissioner of police (zone VI). After finding out that the men had rented an apartment in Mumbra, the police team searched the house to find their clothes and other belongings. ?The five had rented an expensive apartment, saying that they were engineers and had to travel a lot. They did so to avoid staying at lodges and hotels,? added Umap. The team then left for UP on July 5 where they traced the five people who stayed in Meerut and Bulandshahr. After waiting for 12 days and following the five, the police officers arrested them when they gathered at Meerut on Monday to begin their journey to Mumbai. The five identified as Imran Qureshi, 24, Afsal Qureshi, 27, Shahid Shaikh, 35, Sameer Ali, 26, driver, and Irfan Alvi, 35, have allegedly carried out 12 robberies in Mumbai and 25 in Thane and Gujarat.?Although they were school drop outs they had made all arrangements to escape arrest. On searching their car, we found cavities underneath the gear box and steering wheel where they used to stash valuables so that they don?t get caught at nakabandis,? said Umap. The gang has been arrested for the first time. READ?121 crore stolen in 2016, Mumbai cops recovered just ?23 croreMan arrested for breaking into Railway cop?s house

summary	The Mumbai Police has arrested a gang of five robbers accused of robbing 37 homes in Mumbai, Thane, and Gujarat. Police traced the robbers who stayed in Uttar Pradesh and arrested them in Meerut. The robbers would travel by car from Uttar Pradesh to Mumbai and stop on the way to break into houses.
pred	A woman from Chembur had gone to buy vegetables outside her building for a few minutes in April and when she returned she saw that her house was ransacked and her gold jewellery missing. Another woman in Shivaji Nagar went to her daughter's school to pick her up and found her house robbed. The Mumbai and Thane police were getting regular complaints of house break-ins within minutes by unknown thieves.

5 records that have more rogue score:

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text	The Bombay high court has granted compensation of Rs2lakh to a 63-year-old murder convict from Aurangabad because he was kept in jail for three years and nine months beyond his sentence. A division bench of justices TV Nalawade and Sunil Kotwal directed the government to pay the amount to Ranjitsingh Gill within 45 days, failing which it would have to shell out interest at the rate of 12% a year. Gill was arrested in August 1975 on murder charges. He was acquitted by a trial court but the Bombay high court overturned the order and sentenced him to life imprisonment. The high court order was later upheld by the Supreme Court. After serving 17 years and nine months in jail, Gill was released in February 2002. Two years later, he approached the high court, seeking compensation of Rs25 lakh on the grounds that he was illegally detained for three years and nine months beyond the term of his sentence. Though the court agreed that section 433A (giving powers to state to commute or remit sentence)?of the Criminal Procedure Code, which came into effect three years after his conviction, was not applicable in this case, it said that the government had failed to release him on time. ?This court holds that compensation needs to be paid to the petitioner,? ruled the court. ?On the date he submitted his petition, the petitioner was about 50-year-old and it can be said that he lost more than three years of his active life owing to the illegal detention,? said the bench. ?When a person is kept behind bars, his entire family suffers. In our society, the male member is generally the main earner of the family,? it observedREADBombay high court irked with state?s cap on compensation for rape survivors at ?3 lakhBombay high court asks state to compensate student who lost MBBS seat to college irregularities
summary	The Bombay High Court granted a compensation of ?2 lakh to a 63-year-old murder convict as he was illegally detained in jail for three years and nine months beyond his sentence. A bench of justices directed the government to pay him within 45 days, failing which it would have to shell out interest at the rate of 12% a year.
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rouge-l	{'f': 0.8199999950180001, 'p': 0.8723404255319149, 'r': 0.7735849056603774}
text	A Chennai-based NGO today filed a Public Interest Litigation (PIL) in the Supreme Court demanding a CBI probe into the death of former Tamil Nadu Chief Minister J Jayalalithaa.The petition has also asked for the recovery of all medical documents during the AIADMK chief's stay in Chennai's Apollo Hospital for more than two months.Jayalalithaa, 68, died of cardiac arrest on December 5. Her stay in Apollo

	since September 22 was marked by secrecy, forcing many to ask questions about her health and the future of the AIADMK.ALSO READ: What exactly happened to Jayalalithaa? We got this from doctors who know Last week, senior Tamil actor Gautami Tadimalla had written to Prime Minister Narendra Modi, raising questions about the "secrecy" maintained by the Tamil Nadu government during Jayalalithaa's treatment.ALSO READ: How did Jayalalithaa die? Tamil actor Gautami Tadimalla writes to PM Modi for answers
summary	A Chennai-based NGO has filed a Public Interest Litigation (PIL) in the Supreme Court demanding a CBI probe into Late Tamil Nadu Chief Minister J Jayalalithaa's death. The petition has also sought for the recovery of all medical documents during the AIADMK Chief's stay in Chennai's Apollo Hospitals for more than two months.
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rouge-l	{'f': 0.8453608197427995, 'p': 0.8367346938775511, 'r': 0.8541666666666666}
text	Sabzar Ahmad Bhat, the slain Hizbul commander who routinely released his photographs in combat gear for social media, was no braveheart. Details emerging about the terrorist's last moments point at his being more adept at shooting from a smartphone than the Kalashnikov on his shoulder.Senior Army sources, privy to the operation in which Bhat was cornered and neutralised in Tral area of Kashmir's Pulwama district last Saturday, told Mail Today that the 27-year-old terrorist remained in hiding for nearly 10 hours, without firing a single bullet at the troops.Bhat also frantically sent text messages from his handset to gather a crowd of stone-pelters at the encounter site to provide him cover, the sources said.HOW DID ARMY TRACK SABZARSecurity forces had tracked down Bhat's location using technical intelligence provided to the troops on ground by the Jammu and Kashmir police cells. These units have been successful in nailing a large number of terrorists in recent years."The intelligence provided by the police confirmed that Sabzar and Faizan were in a cluster of houses in Saimoo village in Tral area and we laid a cordon on Friday evening around his house," senior Army sources said. The raiding party included Army, Special Operations Groups and state police troops.After laying the cordon, the troops tried to establish contact with Sabzar and his category A accomplice Faizan. There was no retaliation or firing from the terrorists in hiding as forces suspect the two did not want to give away their positions.A large number of weapons including an AK-47 and INSAS assault rifles along with a huge cache of ammunition and other warlike stores, were recovered from the hideout after the operation was over.After failing to establish contact with terrorists, the raiding team decided to "smoke out the rats" and called for fire tenders filled with petrol instead of water.STONE PELTERS TO RESCUE?Meanwhile, Bhat and his accomplice were trying to gather a crowd of stonepelters to be able to escape from the encounter location but the late hours did not get them much help. Sources said their messages betrayed desperation and fear."Petrol was poured inside the first house using hose pipes and it was set on fire but the two did not react. The result in the second house was also the same. But when the troops poured in petrol in the third house around 8:15 am, the two ran out of the house and tried to breach the cordon," the sources said. Before Bhat could open fire, the troops fired a hail of bullets. Within a few seconds, the two "propagandist terrorists" were lying dead on the ground.Army sources said Sabzar, a Class 7 dropout, was a known womaniser and drug addict at the time of his joining the Hizbul Mujahidden two years back. He replaced Burhan Wani who had been killed last year by the Army in South Kashmir.Both the terrorists were tracked by technical intelligence sleuths and killed in similar brief encounters. Sources said in Burhan's case too, the terrorist was trapped when the technical cells of Jammu and Kashmir police had followed a terrorist named Sartaj and did not know about Burhan's presence there.However, in Sabzar's case, they were tracking him directly and were sure about his presence in the Tral area.Sources said the recent crop of local

	terrorists is high on propaganda and try to conjure up a hero-like status by spreading their pictures on social media in full combat gear. "Little do they know that this act of theirs is of big help for security forces in identifying them and locating them," the sources said.As part of Pakistan's strategy, local terrorists, who are not even trained formally into firing and combat tactics, are being used as cannon fodder to keep the militancy in J&K alive.Also Read
summary	Slain Hizbul commander Sabzar Ahmad Bhat remained in hiding for nearly 10 hours without firing a single bullet at the troops during the encounter, Army sources said. Bhat, who succeeded Burhan Wani, also sent text messages from his handset to gather a crowd of stone-pelters at the encounter site to provide him cover, the sources added.
pred	Slain Hizbul commander Sabzar Ahmad Bhat, who released his photographs in combat gear for social media, remained in hiding for nearly 10 hours without firing a single bullet at the troops. He also sent text messages from his handset to gather a crowd of stone-pelters at the encounter site to provide him cover, sources said.
Example 4	
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text	A baby boy, who survived after being buried alive just 10 days after his birth, was put in the shallow grave in Madhya Pradesh?s Barwani by his minor mother who conceived him after rape, investigators said on Thursday.The suspected rapist, also a minor, was arrested after the girl was traced to a village in Maharashtra.The infant was found on July 3 by a tribal couple, who were alerted by his cries from a burial ground at Ghus village, about 64 kms from Barwani. The village is not far from the border with Maharashtra.The baby is admitted to a hospital and will be handed over to the district child welfare committee (CWC), officials said.Despite stringent rape laws, people in rural areas rarely report sexual assaults to police because of the stigma attached. Activists say people also blame the character of the victim, which puts more pressure on families to hide such incidents.Barwani superindent of police, Prashant Khare, said the girl?s family hurriedly married her off to a minor boy after discovering her pregnancy. She said she was raped about a year ago.But her husband, who came to know about the incident, also refused to accept the baby and told her to abandon it, the officer added.Khare said the ?painstaking investigation? took around 20 days.?It was a shock for us when we saw that the mother was a minor, her husband too was a minor as was the rapist,? he added.The girl hails from a village of Barwani and lives with with her husband in Sirpur, Maharashtra. Police said she came to her parents house on July 2 and buried the baby in neighbouring Ghus, about 10 km away.Besides the accused, police have also booked the mother on charges of abandoning the baby and exposing him to danger.?I didn?t want to kill my baby. I requested a lot but nobody supported me, so buried him in a shallow grave,? police quoted the girl as saying.The mother told police she wanted to become a teacher but was forced by her parents to leave her studies.The parents allegedly did not tell her husband that she was carrying a child, the police officer added.
summary	A baby boy, who survived after being buried alive just 10 days after his birth, was put in a grave in Madhya Pradesh by his minor mother who conceived him after rape. The infant was found on July 3 by a tribal couple and the suspected rapist, also a minor, was arrested after the girl was traced in Maharashtra.
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rouge-2	{'f': 0.6601941698369308, 'p': 0.5862068965517241, 'r': 0.7555555555555555}
rouge-l	{'f': 0.7532467483150616, 'p': 0.6744186046511628, 'r': 0.8529411764705882}

text	In a shocking incident, a 15-year-old girl was locked inside a house in east Delhi's Krishna Nagar for two years by her mother.The matter came to light after a neighbour, who suspected that something was not right, informed the Delhi Police, who raided the house and rescued the girl.The room in which the girl was kept was found to be full of garbage.Locals told the police that the woman, Krishna Ghosh, who is the mother of the victim, would visit the house in the evening only to bring food for the girl.
summary	A 15-year-old girl was locked inside a house in east Delhi's Krishna Nagar locality for two years by her mother. The matter came to light after a neighbour informed the Delhi police, who raided the house and rescued the girl. The girl's mother reportedly used to visit the house only in the evening to bring food for the girl.
pred	A 15-year-old girl was locked inside a house in east Delhi's Krishna Nagar for two years by her mother. The woman, Krishna Ghosh, would visit the house in the evening only to bring food for the girl. The police raided the house and rescued the girl.

Some of the Amazon Product Reviews are also summarized using this model:

Example 1	
Actual	Great taffy at a great price. There was a wide assortment of yummy taffy. Delivery was very quick. If your a taffy lover, this is a deal.
Abstractive Summary	The taffy was very good and the delivery was quick. I would recommend this store to anyone who is a taffy lover.
Example 2	
Actual	I have bought several of the Vitality canned dog food products and have found them all to be of good quality. The product looks more like a stew than a processed meat and it smells better.
Abstractive Summary	My Labrador is finicky and she appreciates this product better than most.
Example 3	
Actual	Product arrived labeled as Jumbo Salted Peanuts...the peanuts were actually small sized unsalted. Not sure if this was an error or if the vendor intended to represent the product as "Jumbo".
Abstractive Summary	The peanuts were actually small sized unsalted. Not sure if this was an error or if the vendor intended to represent the product as "Jumbo". I'm not sure if this was an error or if the vendor intended to represent the product as "Jumbo".
Example 4	
Actual	This is a confection that has been around a few centuries. It is a light, pillowy citrus gelatin with nuts - in this case Filberts. And it is cut into tiny squares and then liberally coated with powdered sugar. And it is a tiny mouthful of heaven. Not too chewy, and very flavorful. I highly recommend this yummy treat. If you are familiar with the story of C.S. Lewis' "The Lion, The Witch, and The Wardrobe" - this is the treat that seduces Edmund into selling out his Brother and Sisters to the Witch.
Abstractive Summary	A confection that has been around a few centuries. It is a light, pillowy citrus gelatin with nuts - in this case Filberts. And it is cut into tiny squares and then liberally coated with powdered sugar. Not too chewy, and very flavorful.

Example 5	
Actual	If you are looking for the secret ingredient in Robitussin I believe I have found it. I got this in addition to the Root Beer Extract I ordered (which was good) and made some cherry soda. The flavor is very medicinal.
Abstractive Summary	The secret ingredient in Robitussin is a root beer extract, which I ordered and made some cherry soda. It has a very medicinal flavor and the taste is very medicinal.

Model is doing good comparing to other models. All the texts generated are meaning full and readable.

There are some limitations associated with the implemented model.

- It can support input text length only up to max of 512 tokens
- Summary generated are sometimes lengthier than Actual input text when the input text is very small in length. May be this could also be due to the configuration that we have set in the model that max tokens of the output could be up to 150 words. Need to investigate on this further.

Predicted Summary, Golden Summary and Source Data are taken from the above experiment is taken, preprocessed and then used as source data for the bottom-up summarization.

rouge-1	rouge-2	rouge-l	text	summary	pred
{'f': 0.5468749950305177, 'p': 0.5932203389830...	{'f': 0.3650793601108592, 'p': 0.3965517241379...	{'f': 0.5321100867637405, 'p': 0.5686274509803...	A suspected mortar shell was found at Vasant K...	A suspected mortar shell was found in Vasant K...	A suspected mortar shell was found at a garbag...
{'f': 0.38181817683305785, 'p': 0.403846153846...	{'f': 0.1481481431635804, 'p': 0.1568627450980...	{'f': 0.29787233543458586, 'p': 0.311111111111...	Martin Landau, the chameleon-like actor who ga...	Oscar-winning Hollywood actor Martin Landau pa...	Actor Martin Landau, known for his role in the...
{'f': 0.44444443948979595, 'p': 0.491228070175...	{'f': 0.3387096724661811, 'p': 0.375, 'r': 0.3...	{'f': 0.5094339572801709, 'p': 0.54, 'r': 0.48...	Australia?s consumer watchdog carried out a st...	A sting operation against Apple by Australian ...	Australia's consumer watchdog carried out a st...
{'f': 0.6949152492387246, 'p': 0.7068965517241...	{'f': 0.5344827536221761, 'p': 0.5438596491228...	{'f': 0.7238095188136056, 'p': 0.7037037037037...	Indian boxers Shiva Thapa (60kg), Sumit Sangwa...	Indian boxers Shiva Thapa (60 kg), Sumit Sangw...	Indian boxers Shiva Thapa (60kg), Sumit Sangwa...
{'f': 0.3833333283555556, 'p': 0.4107142857142...	{'f': 0.11864406281959226, 'p': 0.127272727272...	{'f': 0.2912621309605053, 'p': 0.3191489361702...	Prime Minister Narendra Modi inspected on Tues...	Prime Minister Narendra Modi on Tuesday announ...	Prime Minister Narendra Modi on Tuesday inspec...

We have used ELMO-CRF model, it is a BI-LSTM Encoder-Decoder architecture for bottom-up summarization, we have trained it for 2 epochs with batch size of 40.

Bottom-up summarization, takes the output of the previous summarizer as input and golden/reference summary data as target. Then it tries to finetunes the data to the required format.

1st Epoch Result:


```
  "best_epoch": 1,
  "peak_cpu_memory_MB": 2568.592,
  "training_duration": "0:07:49.099059",
  "training_start_epoch": 0,
  "training_epochs": 1,
  "epoch": 1,
  "training_accuracy": 0.5169804181250591,
  "training_accuracy3": 1.0,
  "training_loss": 1121.8753280639648,
  "training_cpu_memory_MB": 2568.592,
  "validation_accuracy": 0.6202742002492729,
  "validation_accuracy3": 1.0,
  "validation_loss": 749.2664489746094,
  "best_validation_accuracy": 0.6202742002492729,
  "best_validation_accuracy3": 1.0,
  "best_validation_loss": 749.2664489746094
}
```


While testing the model on the test data, it is scary that it gave the below results.


```
{'rouge-1': {'f': 0.8832273672020138,
  'p': 0.8719866647191139,
  'r': 0.902755229529357},
 'rouge-2': {'f': 0.8275458530818474,
  'p': 0.8172195428704694,
  'r': 0.8457872274981181},
 'rouge-l': {'f': 0.88944566527051,
  'p': 0.8866425617605953,
  'r': 0.8970366640166965}}
```


It is expected that it behaves better than the original prediction, but not soo huge and when investigating it is found that it improves the result but it is overtrained and also lacking enough data to bench mark its performance.

Future Scope:

- Test various models in Bottom-up-summarization and find the best model and then use it with t5 summarizer.
- These tests has to be executed in a larger and standard dataset for accuracy
- There is a limitation in transformer as it supports good up to 512 words for summarization, this can also be tested with BERT based summarizer for handling bigger texts

References:

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https://arxiv.org/abs/1704.04368

https://arxiv.org/abs/1812.02303

and more……