SFU

Employing Neural Hierarchical Model with Pointer Generator Networks for Abstractive Text Summarization

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Introduction

Extractive Summarization: 

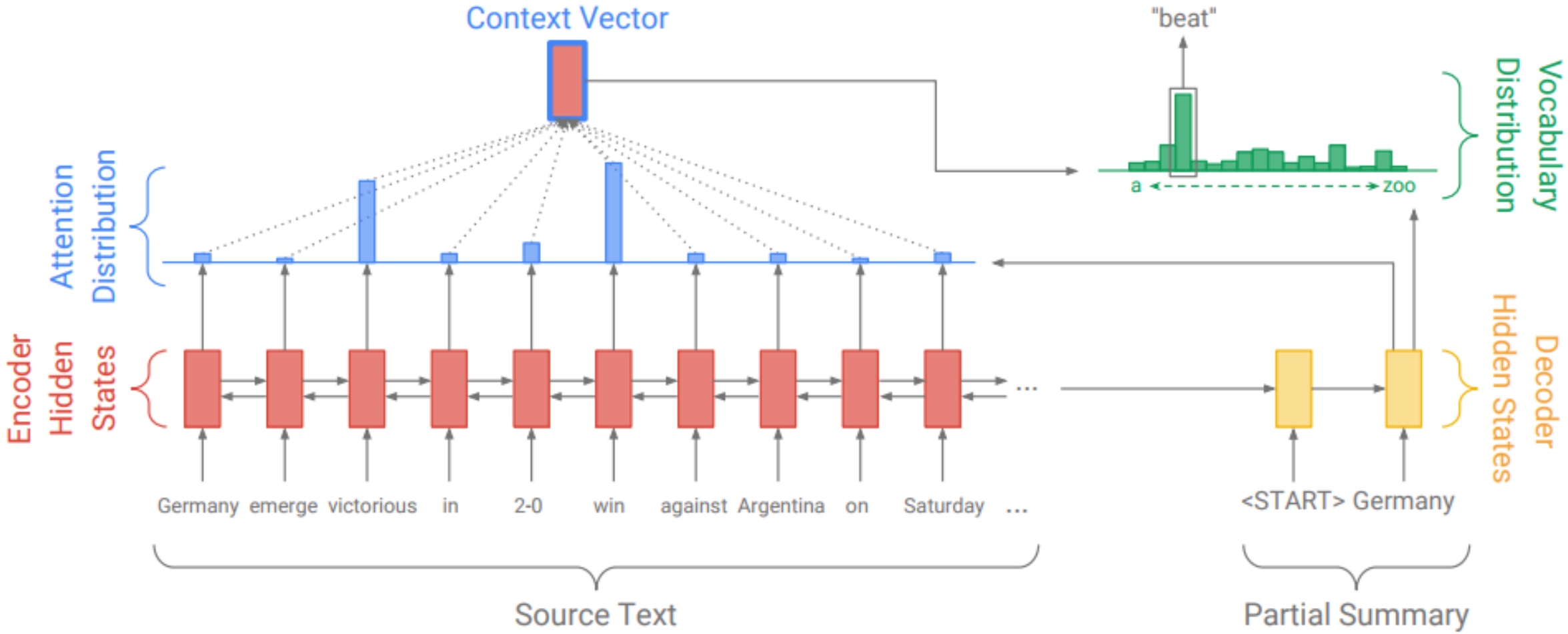
The generated summary is a selection of relevant sentences from the source text in a copy-paste fashion.

Abstractive Summarization: 

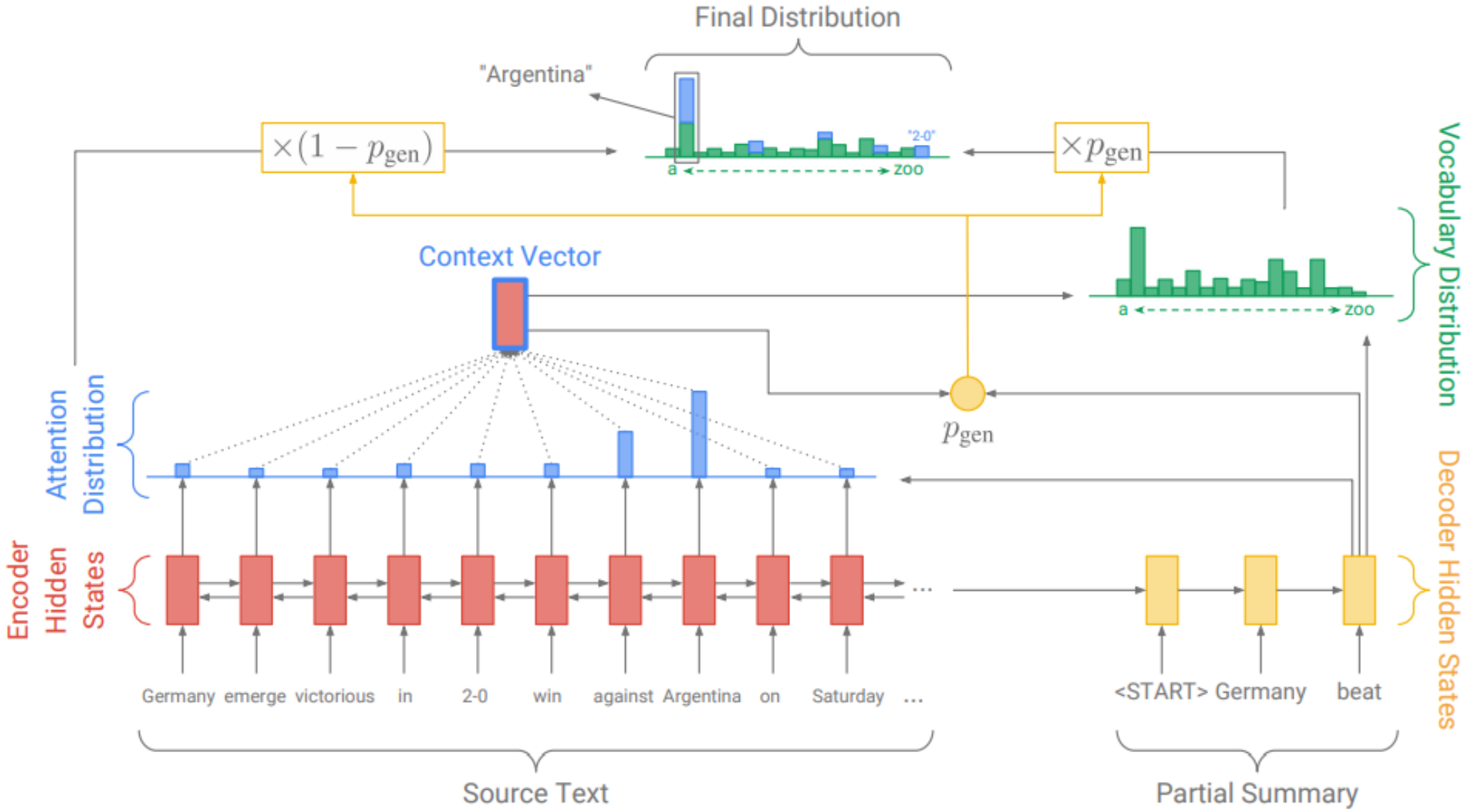
The generated summary is a new cohesive text not necessarily present in the original source.

Thesis Outline

1. Introduction
2. **Background**
3. System architecture
4. Evaluation
5. Concluding remarks



Abstractive text summarization using sequence-to-sequence RNNs,
Rush et al. [2]



Summarization with pointer generator networks,
See et al. [5]

Input document (truncated):
(cnn) chile 's calbuco volcano erupted again thursday , marking the third time since last week , the national service of geology and mining said . gregorio billikopf lives across lake llanquihue from the volcano has been photographing and videotaping the three eruptions and described thursday 's event as spectacular but not as severe as the two prior ones . `` there is still smoke on and off , but nothing so dramatic ( as before ) , '' said billikopf , a retired university adviser on agricultural issues . `` on a good day i can see about eight volcanoes . `` i understand that the rain that was announced for today would have been a disaster , '' he added . he lives in a rainy part of chile , which he described as like a garden of eden . the explosion produced an extensive plume , but it was also described as smaller than the eruptions on april 22 and april 23 , according to cnn chile . deputy interior minister mahmud aleuy said about 1,500 people were evacuated , (….)

Reference:
`` there is still smoke on and off , '' says resident with distant view .
the volcano erupts for third time since april 22 .
about 1,500 people are evacuated , an official says , according to cnn chile .

Attentional Encoder-Decoder Model:
UNK volcano erupted again thursday .
UNK volcano has been erupting since last week , the national service of sciences says .
`` there is still smoke on and off , but nothing so big , '' he says .

Pointer Generator Networks Model:
chile 's calbuco volcano erupted again thursday .
gregorio billikopf lives across lake llanquihue from the volcano .
he lives in a rainy part of chile , which he described as like a garden of eden .

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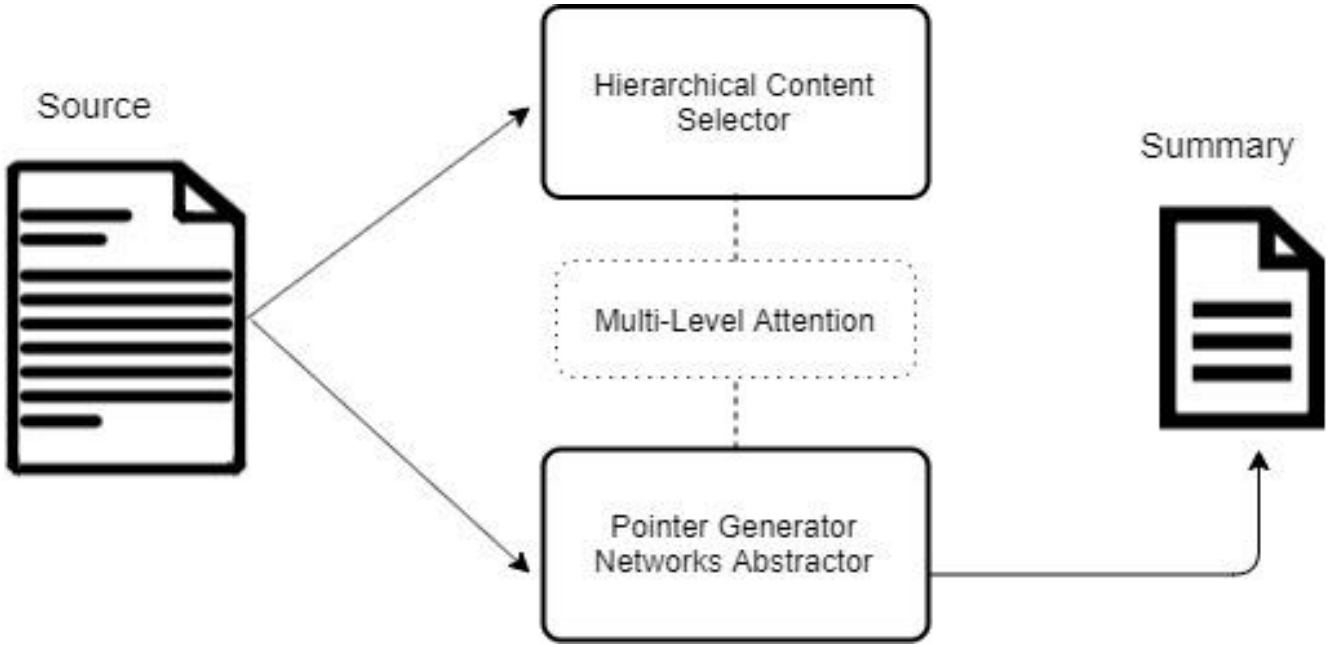
Problem Definition

Given an input *x*, the objective is to select $\acute{y}$ from the candidate output sequences by modeling,

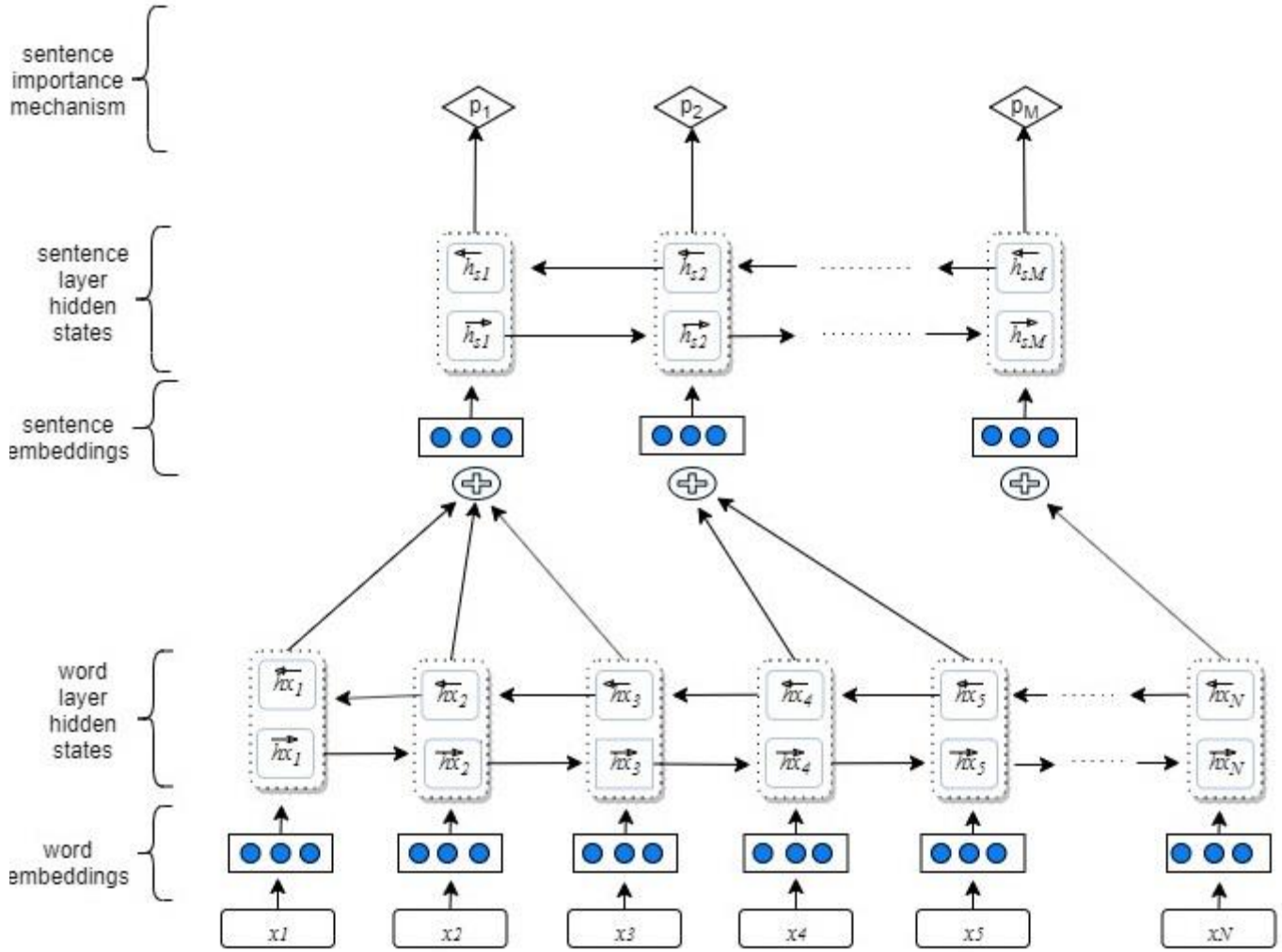
$$\acute{y} = argmax_y \, log \, P(y|x)$$

Here, $y = y_1, \ldots\ldots, y_L$ with $L < |x|$, and each $y_t \in V_y$ while $x = x_1, x_2, \ldots\ldots, x_N$ belonging to M sentences, and each $x_k \in V_x$

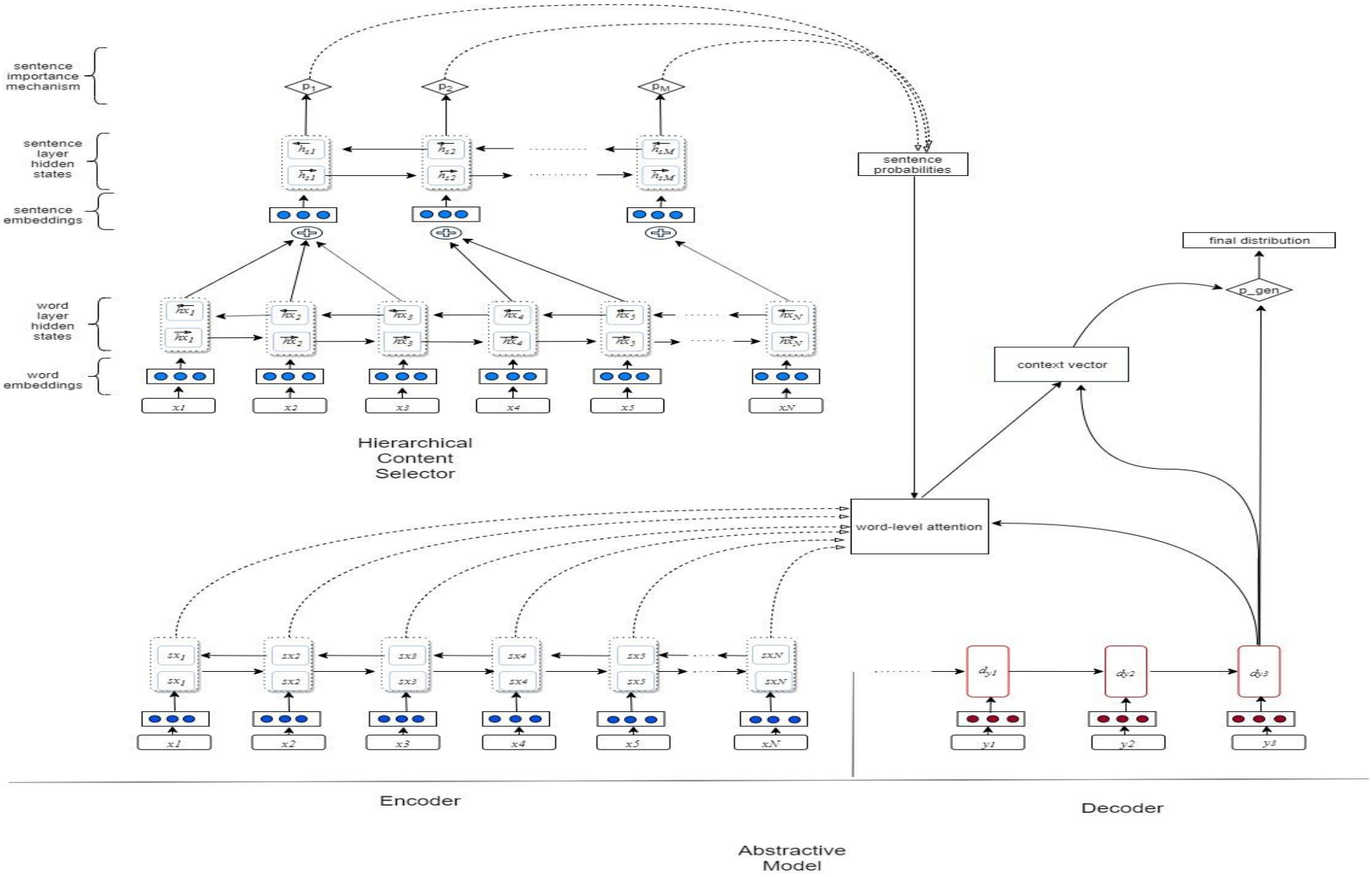
V x D_w where $V = |V_x| + |V_y|$



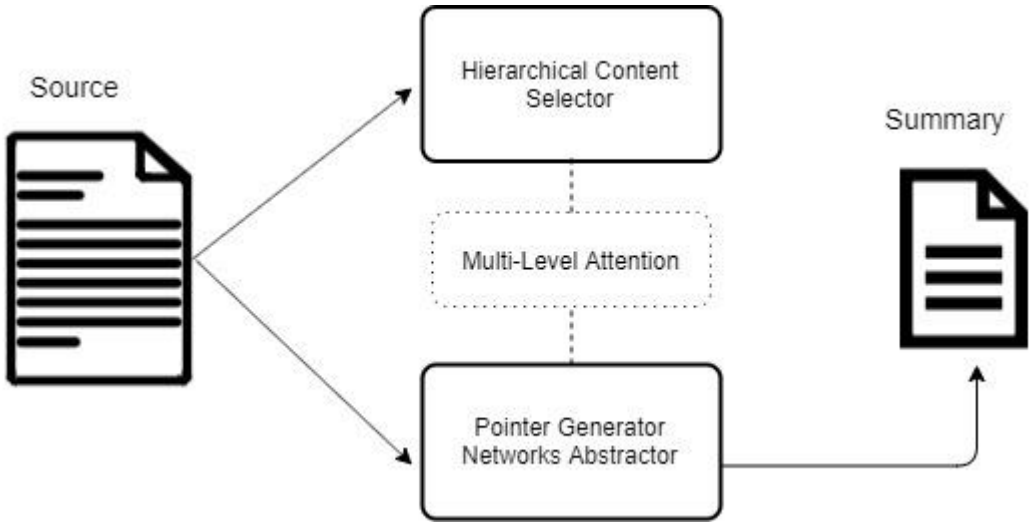
Block diagram of our end-to-end model



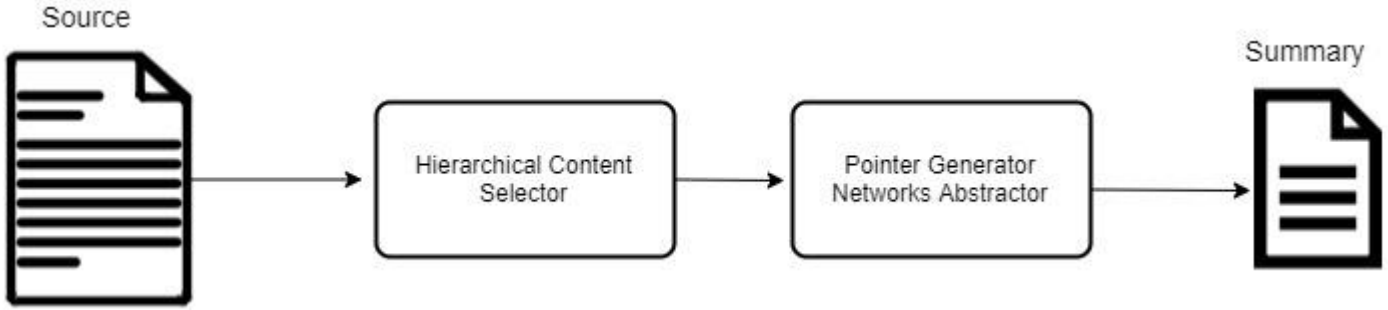
Hierarchical Content Selector



Complete system architecture



Block diagram of our end-to-end model



Block diagram of the submodules trained separately

Reference:

trip will come before pope francis arrives in united states .

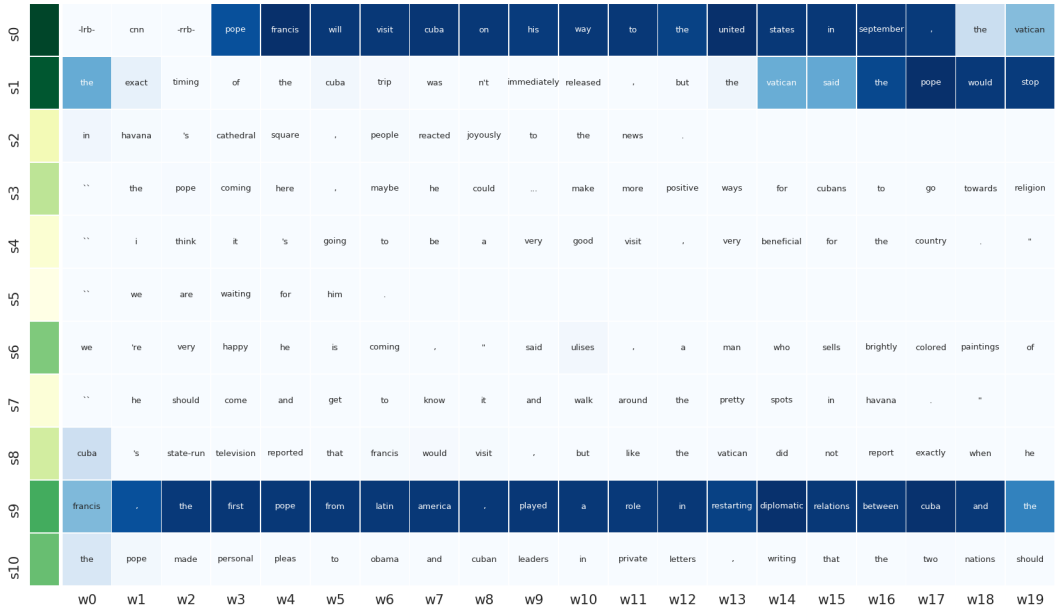
francis played key role in re-establishing diplomatic ties between cuba and u.s.

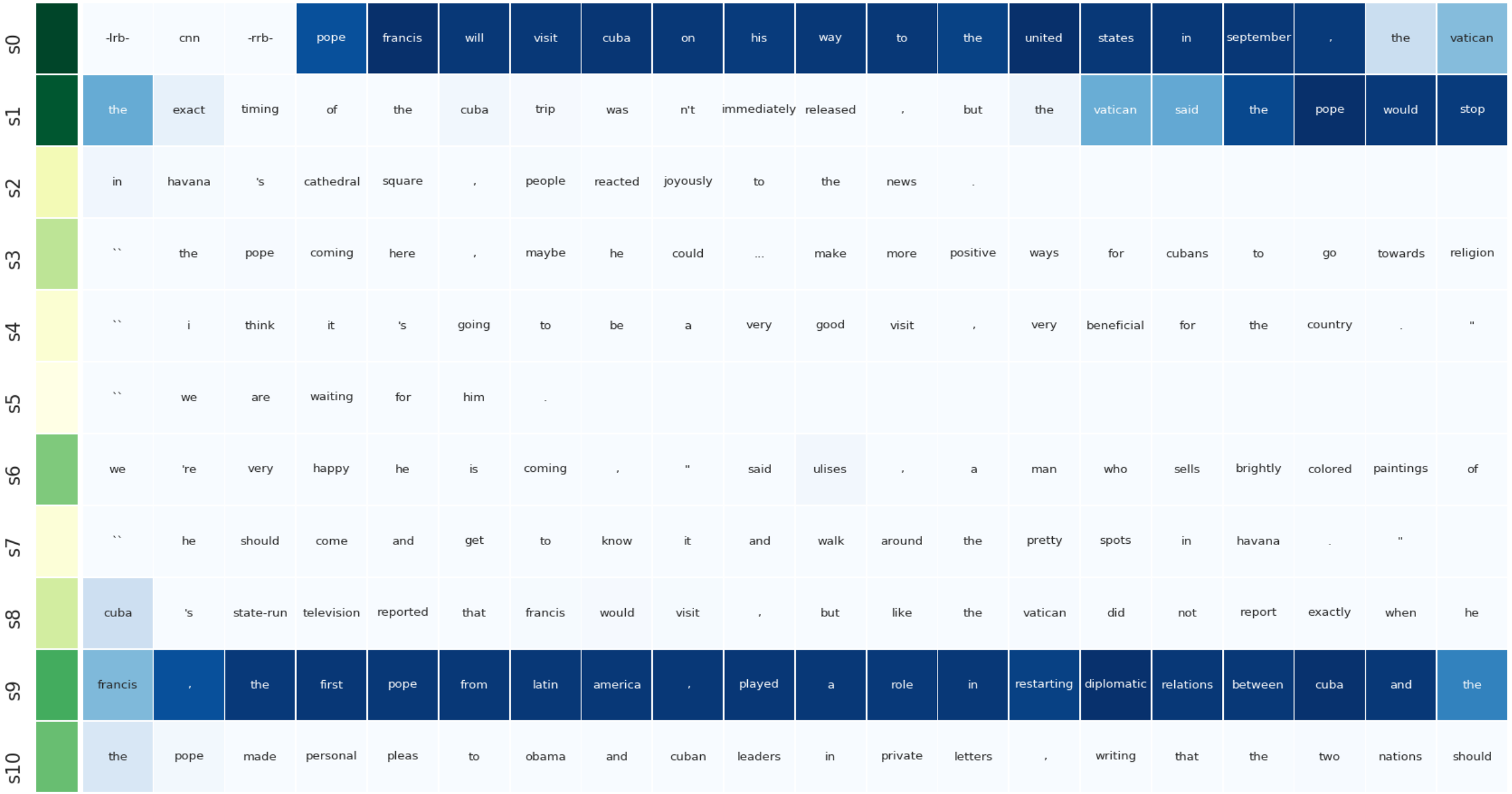
Decoded:

pope francis will visit cuba on his way to the united states in september .

the vatican said the pope would stop in cuba before his planned late september stops in washington , new york and philadelphia .

francis , the first pope from latin america , played a role in restarting diplomatic relations between cuba and the united states .




s0 -lrb- cnn -rrb- pope francis will visit cuba on his way to the united states in september , the vatican
s1 the exact timing of the cuba trip was n't immediately released , but the vatican said the pope would stop
s2 in havana 's cathedral square , people reacted joyously to the news .
s3 `` the pope coming here , maybe he could ... make more positive ways for cubans to go towards religion
s4 `` i think it 's going to be a very good visit , very beneficial for the country . "
s5 `` we are waiting for him .
s6 we 're very happy he is coming , " said ulises , a man who sells brightly colored paintings of
s7 `` he should come and get to know it and walk around the pretty spots in havana . "
s8 cuba 's state-run television reported that francis would visit , but like the vatican did not report exactly when he
s9 francis , the first pope from latin america , played a role in restarting diplomatic relations between cuba and the
s10 the pope made personal pleas to obama and cuban leaders in private letters , writing that the two nations should
w0 w1 w2 w3 w4 w5 w6 w7 w8 w9 w10 w11 w12 w13 w14 w15 w16 w17 w18 w19

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ROUGE scores:

- Increase in ROUGE-1 by 1.02%, ROUGE-2 by 1.71%, and ROUGE-L by 1.18% → Separate training
- Increase in ROUGE-1 by 2.3%, ROUGE-2 by 3.13%, and ROUGE-L by 1.57% → Pointer generator networks
- Increase in ROUGE-1 by 0.25%, ROUGE-2 by 0.68%, and ROUGE-L by 1.04% → Lead-3 baseline
- +2.07 points in ROUGE-2, -0.72 points in ROUGE-1 and -2.13 points in ROUGE-L → Abstractor-RL

METEOR scores:

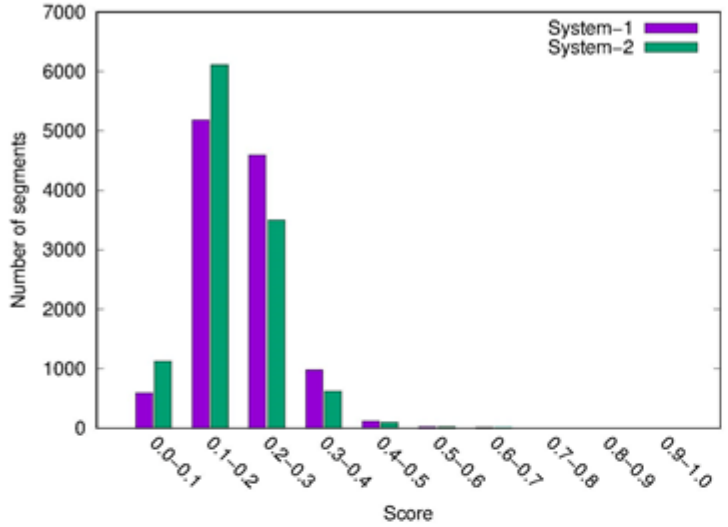
- Increase in recall by 13.9% → Exact mode
- Increase in recall by 13.6% → Full mode
- Increase in final score by 11.1% → Exact mode
- Increase in final score by 10.7% → Full mode

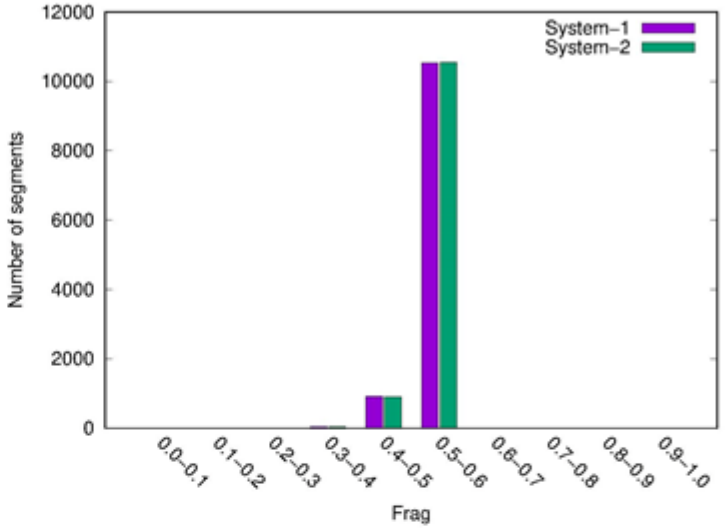
Source document: Jenson Button was denied his 100th race for McLaren after an ERS prevented him from making it to the startline. It capped a miserable weekend for the Briton; his time in Bahrain plagued by reliability issues. Button spent much of the race on Twitter delivering his verdict as the action unfolded. 'Kimi is the man to watch,' and 'loving the sparks', were among his pearls of wisdom, but the tweet which courted the most attention was a rather mischievous one: 'Ooh is Lewis backing his team mate into Vettel?' he quizzed after Rosberg accused Hamilton of pulling off such a manoeuvre in China. Jenson Button waves to the crowd ahead of the Bahrain Grand Prix which he failed to start Perhaps a career in the media beckons... Lewis Hamilton has out-qualified and finished ahead of Nico Rosberg at every race this season. Indeed Rosberg has now beaten his Mercedes team-mate only once in the 11 races since the pair infamously collided in Belgium last year. Hamilton secured the 36th win of his career in Bahrain and his 21st from pole position. Only Michael Schumacher (40), Ayrton Senna (29) and Sebastian Vettel (27) have more. (...)

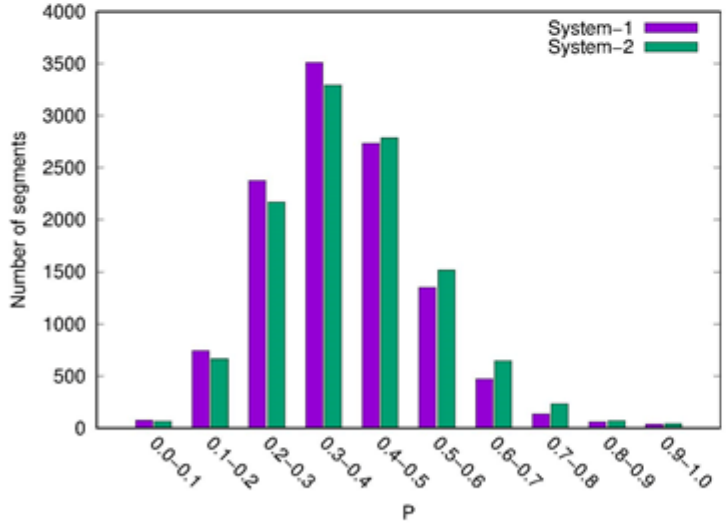
Ground truth summary: Button denied 100th race start for McLaren after ERS failure. Button then spent much of the Bahrain Grand Prix on Twitter delivering his verdict on the action as it unfolded. Lewis Hamilton has out-qualified and finished ahead of Mercedes team-mate Nico Rosberg at every race this season. Bernie Ecclestone confirms F1 will make its bow in Azerbaijan next season.

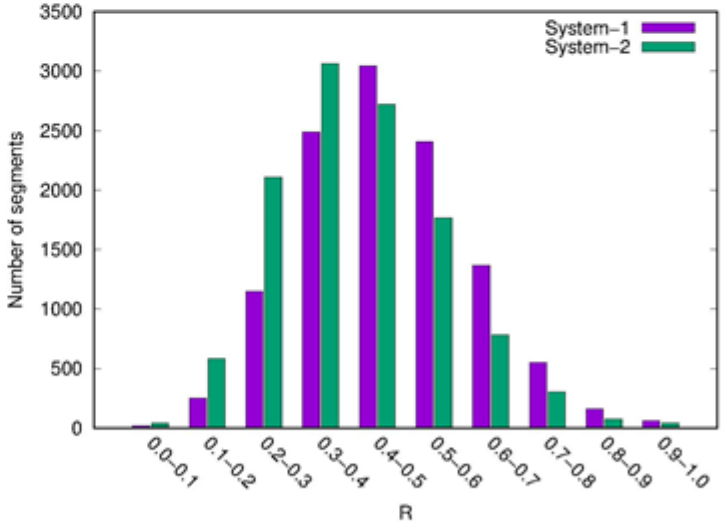
ML (ROUGE-1 41.58): Button was denied his 100th race for McLaren. ERS prevented him from making it to the start-line. The Briton. He quizzed after Nico Rosberg accused Lewis Hamilton of pulling off such a manoeuvre in China. Button has been in Azerbaijan for the first time since 2013.

RL (ROUGE-1 50.00) Button was denied his 100th race for McLaren after an ERS prevented him from making it to the start-line. It capped a miserable weekend for the Briton. Button has out-qualified. Finished ahead of Nico Rosberg at Bahrain. Lewis Hamilton has. In 11 races. . The race. To lead 2,000 laps. . In. . . And. .

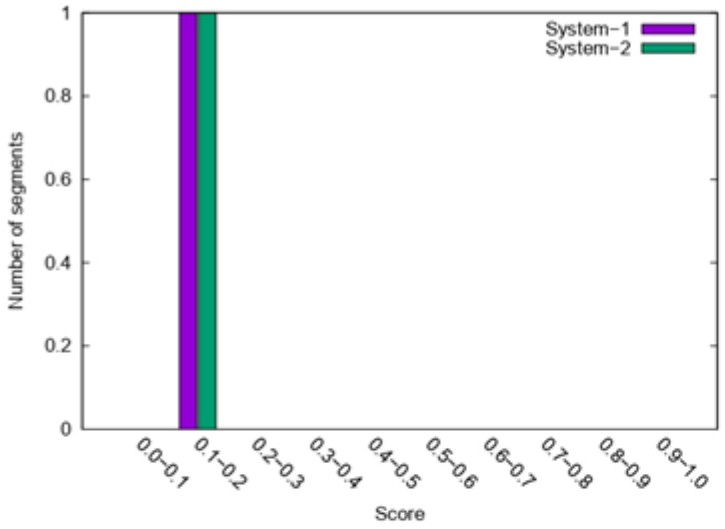




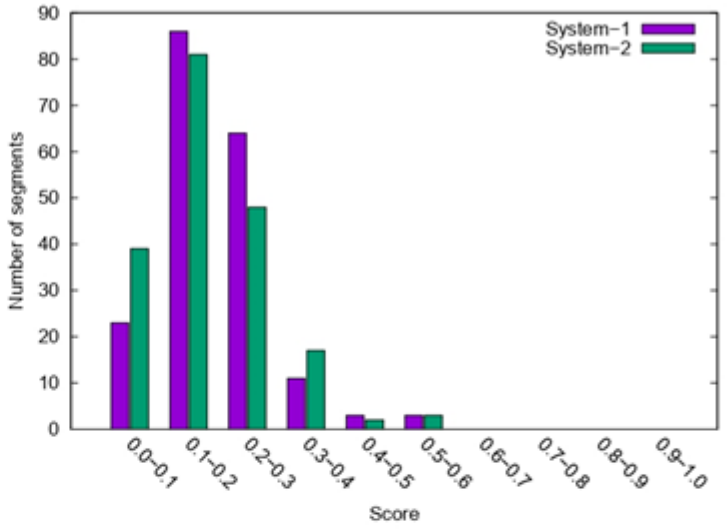




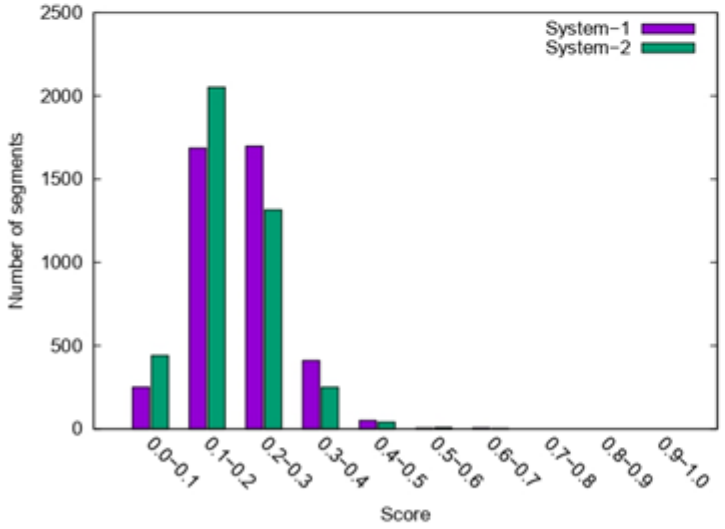
METEOR statistics for all test-set summaries



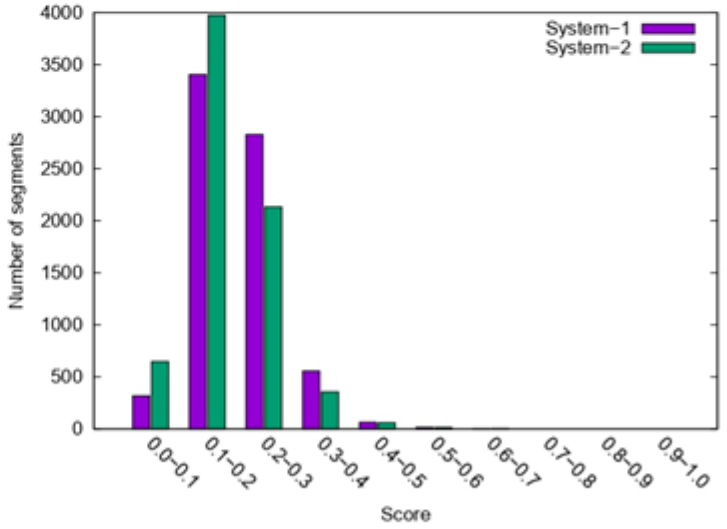
1–10 words



11-25 words



26–50 words



51+ words

METEOR scores by summary length

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Contribution

- We propose an end-to-end neural network framework which combines a hierarchical content selector and pointer generator networks-based abstractor through a multi-level attention mechanism.

- We perform quantitative and qualitative analysis on the test dataset of CNN/Daily Mail joint corpus and show that our end-to-end model can produce summaries which are better at capturing aboutness of the input documents.
  - +0.91 in ROUGE-1, +0.54 in ROUGE-2, +0.57 in ROUGE-L
  - +1.86 in METEOR-Exact, +2.04 in METEOR-Full

References

1. R. Nallapati, F. Zhai, and B. Zhou. SummaRuNNer: A recurrent neural network-based sequence model for extractive summarization of documents. In *Proceedings of the Thirty-First AAAI Conference on Artificial Intelligence (AAAI-17)*, pages 3075–3081, 2017.
2. R. Nallapati, B. Zhou, C.N. dos santos, C. Gulcehre, and B. Xiang. Abstractive text summarization using sequence-to-sequence rnns and beyond. In *Proceedings of the 20th SIGNLL Conference on Computational Natural Language Learning*, pages 280–290, 2016.
3. A. See, P.J. Liu, and C.D. Manning. Get to the point: Summarization with pointer generator networks. In *Proceedings of the 55th Annual Meeting of the Association for Computational Linguistics*, volume 1, pages 1073–1083, 2017.
4. R. Paulus, C. Xiong, and R. Socher. A deep reinforced model for abstractive summarization. *arXiv preprint arXiv:1705.04304*, 2017.
5. A. See, P.J. Liu, and C.D. Manning. Get to the point: Summarization with pointer generator networks. In *Proceedings of the 55th Annual Meeting of the Association for Computational Linguistics*, volume 1, pages 1073–1083, 2017.
6. C. Li, W. Xu, S. Li, and S. Gao. Guiding generation for abstractive text summarization based on key information guide network. In *Proceedings of the 2018 Conference of the North American Chapter of the Association for Computational Linguistics: Human Language Technologies*, volume 2, pages 55–60, 2018.
7. W.T. Hsu, C.K. Lin, M.Y. Lee, K. Min, J. Tang, and M. Sun. A unified model for extractive and abstractive summarization using inconsistency loss. *arXiv preprint arXiv:1805.06266*, 2018.

Thank You
Questions?