A Supplemental Material

A.1 Details of the Implementation

We implemented our model in PyTorch and trained it on four Nvidia Tesla P100 GPUs. The RNN was a gated recurrent unit (GRU) (Cho et al., 2014). The optimizer was Adam (Kingma and Ba, 2014). The word-based word embeddings were fixed GloVe 300-dimensional vectors (Pennington et al., 2014). The character-based word embeddings were obtained using trainable eight-dimensional character embeddings and a 100-dimensional CNN and max pooling. Table 1 shows other hyper parameters.

In FEVER, if the model predicts A_T as 'Supports' or 'Refutes', the model extracts at least one sentence by removing the EOE sentence from the candidates to be extracted at t = 1.

A.2 Samples of QFE Outputs

The section describes some examples of QFE outputs. Table 2 shows examples on HotpotQA, and Table 3 shows examples on FEVER. We should note that QFE does not necessarily extract the sentence with the highest probability score at any step because QFE determines the evidence by using the beam search algorithm.

Three or four correct evidence sentences are extracted in the first and second examples in Table 2. The third example is a typical mistake of QFE; QFE extracts too few evidence sentences. In the fourth example, QFE extracts too many evidence sentences. The fifth and sixth questions are typical yes/no questions in HotpotQA. However, like other QA models, our model makes mistakes in answering such easy questions.

One or two evidence sentences are extracted correctly in the first, second, and third examples in Table 3. In FEVER, most claims requiring two evidence sentences can be verified by either of two correct evidence sentences, like in the second example. However, there are some claims that require both evidence sentences, like the third example. The fourth example is a typical mistake of QFE; QFE extracts too few evidence sentences. In the fifth and sixth example, the answers of the questions are 'Not Enough Info'. QFE unfortunately extracts evidence when the QA model predicts another label.

	HotpotQA	FEVER
size of word vectors: d_w	400	435
width of RNN: d_c	150	150
dropout keep ratio	0.8	0.8
batch size	72	96
learning rate	0.001	0.001
beam size	5	5

Table 1: Hyper Parameters.

References

- Kyunghyun Cho, Bart Merrienboer, Caglar Gulcehre, Fethi Bougares, Holger Schwenk, and Yoshua Bengio. 2014. Learning phrase representations using rnn encoder-decoder for statistical machine translation. In *EMNLP*, pages 1724–1734.
- Diederik P. Kingma and Jimmy Ba. 2014. Adam: A method for stochastic optimization. *arXiv preprint arXiv:1412.6980*.
- Jeffrey Pennington, Richard Socher, and Christopher D. Manning. 2014. GloVe: Global vectors for word representation. In *EMNLP*, pages 1532–1543.

	Manglietia,	\hat{A}_T : Manglietia	
-	predicted	probability[%]	text
\checkmark	1	85.4	Abronia is a genus of about 20 species of
\checkmark	2	$14.6 \rightarrow 54.5$	Manglietia is a genus of flowering plants in the family Magno liaceae.
\checkmark	3	$0.0 \rightarrow 45.1 \rightarrow 61.4$	There are about 40 species native to Asia.
	4	$0.0 \rightarrow 0.0 \rightarrow 37.2 \rightarrow 99.2$	EOE sentence
-	-		can heavy metal band formed in what year?
	991, \hat{A}_T :		
gold	predicted	probability[%]	text
\checkmark	1	100.0	Formed on October 12, 1991, the group was founded by vocal ist/guitarist Robb Flynn and bassist Adam Duce.
\checkmark	2	0.0 ightarrow 98.8	Other bands that were featured included Machine Head, Slip knot, and Amen.
\checkmark	3	$0.0 \rightarrow 0.0 \rightarrow 97.7$	Machine Head is an American heavy metal band from Oakland California.
\checkmark	4	$0.0 \rightarrow 1.1 \rightarrow 1.4 \rightarrow 97.3$	Livin La Vida Loco by Ricky Martin, was a concert tour in 1999.
	5	$0.0 \rightarrow 0.0 \rightarrow 0.9 \rightarrow 2.0 \rightarrow 97.0$	EOE sentence
Q: W	here is the s	inger of "B Boy" raised?	
	hiladelphia,		
gold	predicted	probability[%]	text
\checkmark	1	100.0	Raised in Philadelphia, he embarked
1	2	0.0 ightarrow 100.0	"B Boy" is a song by American hip hop recording artist Mee
•			Mill.
	3	$0.0 \rightarrow 0.0 \rightarrow 79.0$	EOE sentence
\checkmark	—	$0.0 \rightarrow 0.0 \rightarrow 20.8$	Robert Rihmeek Williams known by his stage name, Mee Mill,
-		series involves characters such as Nick F	Fury and Baron von Strucker?
		T: Sgt. Fury	
gold	predicted	probability[%]	text
\checkmark	1	70.7	
\checkmark	1	70.7	Andrea von Strucker characters appearing in American comic books published by Marvel Comics.
√	1 2	70.7 1.7 → 41.6	comic books published by Marvel Comics.
~	2	1.7 ightarrow 41.6	comic books published by Marvel Comics. It is the first series to feature Nick Fury Jr. as its main character
V			comic books published by Marvel Comics.
V	2 3 4	$1.7 \rightarrow 41.6$ $17.3 \rightarrow 38.2 \rightarrow 31.6$ $0.0 \rightarrow 0.0 \rightarrow 41.6 \rightarrow 92.0$	comic books published by Marvel Comics. It is the first series to feature Nick Fury Jr. as its main character Nick Fury is a 2017 ongoing comic book series published by
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√	2 3 4	$1.7 \rightarrow 41.6$ $17.3 \rightarrow 38.2 \rightarrow 31.6$ $0.0 \rightarrow 0.0 \rightarrow 41.6 \rightarrow 92.0$	comic books published by Marvel Comics. It is the first series to feature Nick Fury Jr. as its main character Nick Fury is a 2017 ongoing comic book series published b Marvel Comics. EOE sentence
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Table 2: Outputs of QFE on HotpotQA. The sentences are extracted in the order shown in the predicted column. The extraction scores of the sentences at each step are in the probability column.

goldpredictedprobability[%]texttext \checkmark 198.0Soul Food is a 1997 American comedy-drama film and released by Fox 2000 Pictures.2 $0.0 \rightarrow 75.9$ EOE sentencegoldpredictedprobability[%]text \checkmark 196.0Terry Alan Crews is an American actor , artist , and former American football player. \checkmark 2 $3.8 \rightarrow 56.4$ In football , Crews played as 3 $0.0 \rightarrow 41.8 \rightarrow 86.4$ EOE sentence $Q:$ Jack Falahee is an actor and he is unknown. $A_T:$ Refutes $q:$ Jack Falahee is an actor and he is unknown. $A_T:$ Refutes $q:$ Jack Falahee is an actor and he is unknown. $A_T:$ Refutes $q:$ Jack Falahee is an actor and he is unknown. $A_T:$ Refutes $q:$ Jack relatee is an actor second the is unknown for his role as Connor Walsh on 3 $0.0 \rightarrow 32.9 \rightarrow 100.0$ EOE sentence $Q:$ Same Old Love is disassociated from Selena Gomez. $A_T:$ Refutes $q:$ Q: Annette Badland was in the 2015 NBA Finals $A_T:$ Not Enough Info $q:$ Annette Badland was in the 2015 NBA Finals $A_T:$ Not Enough Info $q:$ Billboard Dad is a genre of music. $A_T:$ Not Enough Info $q:$ Billboard Dad is a genre of music. $A_T:$ Not Enough Info $q:$ Billboard Dad is a genre of music. $A_T:$ Not Enough Info $q:$ Billboard Dad is a genre of music. $A_T:$ Not Enough Info $q:$ Billboard Dad is a genre of music. $A_T:$ Not Enough Info $q:$ Billboard Dad is a genre of music. $A_T:$ Not Enough Info $q:$ An	Q: Fo	Q: Fox 2000 Pictures released the film Soul Food. A_T : Supports \hat{A}_T : Supports					
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	gold	predicted	probability[%]	text			
$- 0.00 \rightarrow 83.5 \qquad \text{EOE sentence}$		1	98.4	· · · ·			
		-	0.00 ightarrow 83.5	EOE sentence			

Table 3: Outputs of QFE (single model) on FEVER. The sentences are extracted in the order shown in the predicted column. The extraction scores of the sentences at each step are in the probability column.