

NEURAL TEXT GENERATION IN STORIES USING ENTITY REPRESENTATIONS AS CONTEXT

Elizabeth Clark Yangfeng Ji Noah A. Smith

Paul G. Allen School of Computer Science & Engineering
University of Washington

NAACL 2018



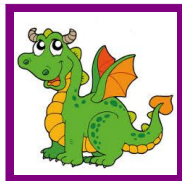
Context: All of a sudden, Emily walked towards the dragon.

Current Sentence: Seth yelled at her to get back but

MOTIVATION

Context: All of a sudden, [Emily]₁ walked towards [the dragon]₂.

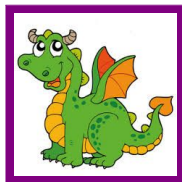
Current Sentence: [Seth]₃ yelled at [her]₁ to get back but



MOTIVATION

Context: All of a sudden, [Emily]₁ walked towards [the dragon]₂.

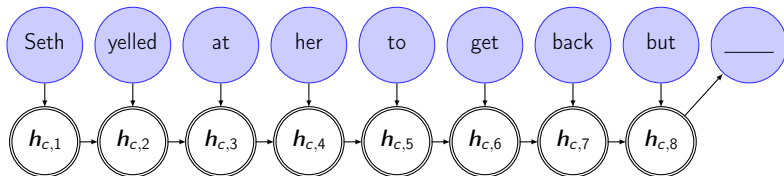
Current Sentence: [Seth]₃ yelled at [her]₁ to get back but [she]₁ ignored [him]₃.



- Can we use entity representations as a form of context to improve text generation for stories?
- Three evaluations:
 1. Mention generation
 2. Sentence selection
 3. Human evaluation

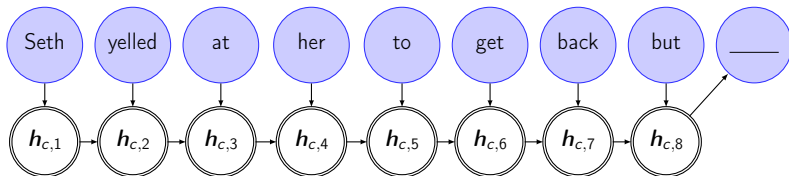
SEQ2SEQ WITH ATTENTION

Current Sentence:

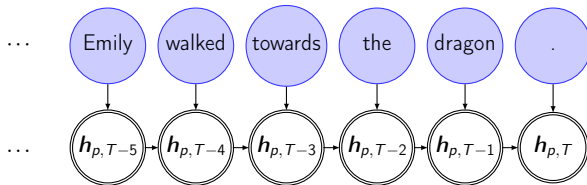


SEQ2SEQ WITH ATTENTION

Current Sentence:

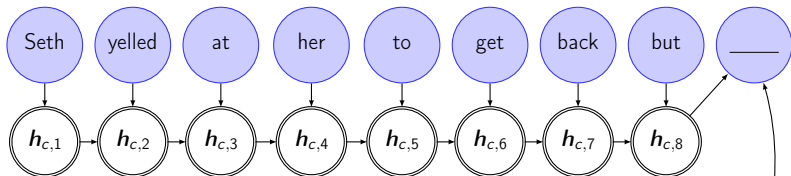


Previous Sentence:

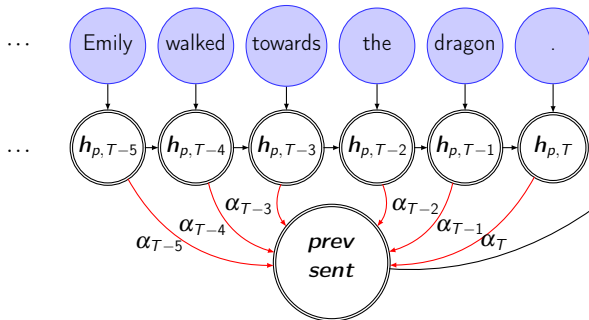


SEQ2SEQ WITH ATTENTION

Current Sentence:



Previous Sentence:



EXAMPLE STORY GENERATION



Legend:

- **Seq2Seq**
- **Human**

Clark et al. (2018)

EXAMPLE STORY GENERATION

“This is ridiculous,” said Duke.

“Yesterday I felt fine, and now you’re telling me I’m at death’s door?!”



Legend:

- **Seq2Seq**
- **Human**

Clark et al. (2018)

EXAMPLE STORY GENERATION

“This is ridiculous,” said Duke.
“Yesterday I felt fine, and now you’re
telling me I’m at death’s door?!”
“We’ll take care of Furbie tomorrow,”
the doctor said.



Legend:

- **Seq2Seq**
- **Human**

Clark et al. (2018)

EXAMPLE STORY GENERATION

“This is ridiculous,” said Duke.

“Yesterday I felt fine, and now you’re telling me I’m at death’s door?!”

“We’ll take care of Furble tomorrow,” the doctor said.

“You’ve named my tumor?!” Duke shrieked.



Legend:

- **Seq2Seq**
- **Human**

Clark et al. (2018)

EXAMPLE STORY GENERATION

“This is ridiculous,” said Duke.

“Yesterday I felt fine, and now you’re telling me I’m at death’s door?!”

“We’ll take care of Furple tomorrow,” the doctor said.

“You’ve named my tumor?!” Duke shrieked.

“Yeah,” replied the doctor coolly, “we’ve found that anthropomorphizing tumors helps people in your position come to terms with their condition more easily.”



Legend:

- Seq2Seq
- Human

Clark et al. (2018)

EXAMPLE STORY GENERATION

“This is ridiculous,” said Duke.

“Yesterday I felt fine, and now you’re telling me I’m at death’s door?!”

“We’ll take care of Furple tomorrow,” the doctor said.

“You’ve named my tumor?!” Duke shrieked.

“Yeah,” replied the doctor coolly, “we’ve found that anthropomorphizing tumors helps people in your position come to terms with their condition more easily.”

Lance yells over the speakers “no sudden hammering”



Legend:

- Seq2Seq
- Human

Clark et al. (2018)

COHERENT MENTION GENERATION

Context:

All of a sudden, [Emily]₁ walked towards [the dragon]₂.

Current Sentence:

[Seth]₃ yelled at [her]₁ to get back but _____.

Option A:

✓ [she]₁ ignored [him]₃.

Option B:

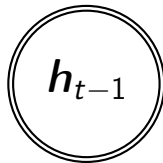
✗ [Emily]₁ ignored [Seth]₃.

Grosz et al. (1995)

Hobbs (1979)

THREE FORMS OF CONTEXT

The current sentence



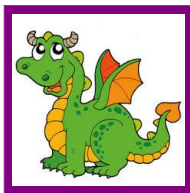
The previous sentence



The entities



ENTITY REPRESENTATIONS



Context:

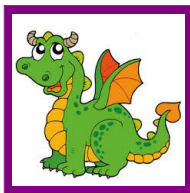
All of a sudden, [Emily]₁ walked towards [the dragon]₂.

Current Sentence:

[Seth]₃ yelled at [her]₁ to get back but _____

Ji et al. (2017)

ENTITY REPRESENTATIONS



Context:

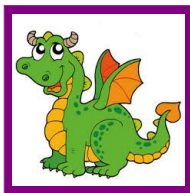
All of a sudden, [Emily]₁ walked towards [the dragon]₂.

Current Sentence:

[Seth]₃ yelled at [her]₁ to get back but _____

Ji et al. (2017)

ENTITY REPRESENTATIONS



Context:

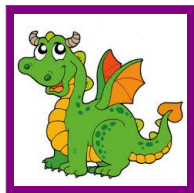
All of a sudden, [Emily]₁ walked towards [the dragon]₂.

Current Sentence:

[Seth]₃ yelled at [her]₁ to get back but _____

Ji et al. (2017)

ENTITY REPRESENTATIONS



Context:

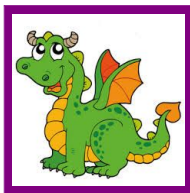
All of a sudden, [Emily]₁ walked towards [the dragon]₂.

Current Sentence:

[Seth]₃ yelled at [her]₁ to get back but _____

Ji et al. (2017)

ENTITY REPRESENTATIONS



Context:

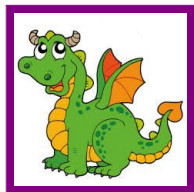
All of a sudden, [Emily]₁ walked towards [the dragon]₂.

Current Sentence:

[Seth]₃ yelled at [her]₁ to get back but _____

Ji et al. (2017)

ENTITY REPRESENTATIONS FOR GENERATION



Context:

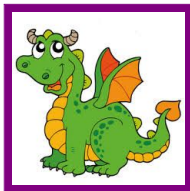
All of a sudden, [Emily]₁ walked towards [the dragon]₂.

Current Sentence:

[Seth]₃ yelled at [her]₁ to get back but _____



ENTITY REPRESENTATIONS FOR GENERATION



Context:

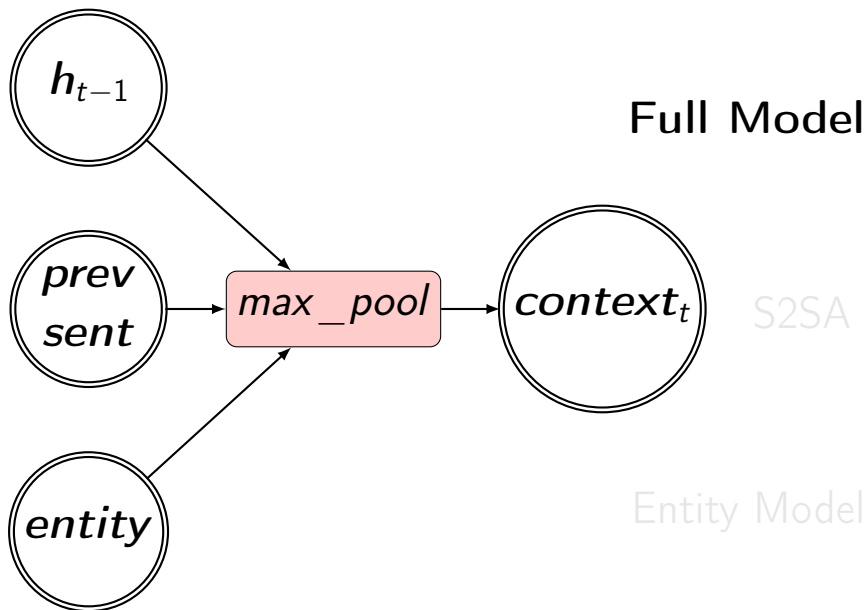
All of a sudden, [Emily]₁ walked towards [the dragon]₂.

Current Sentence:

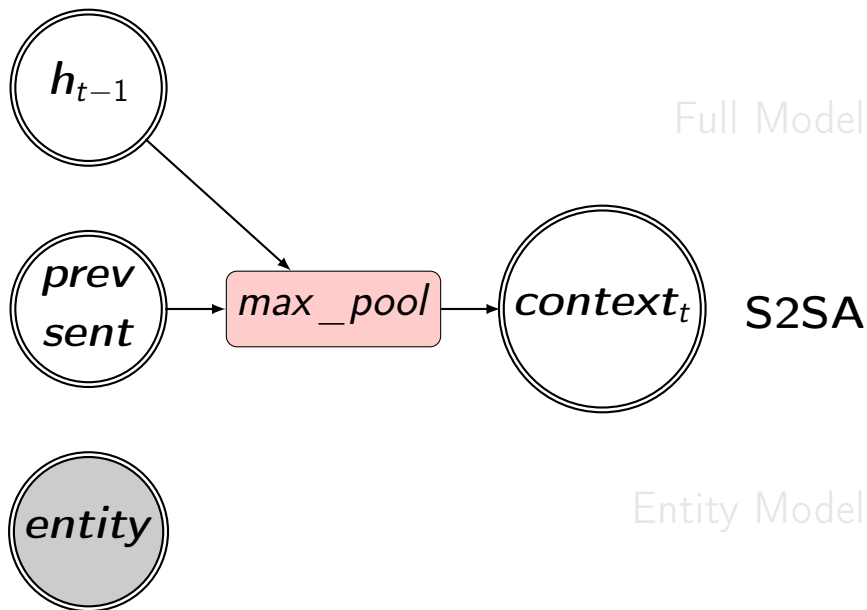
[Seth]₃ yelled at [her]₁ to get back but _____



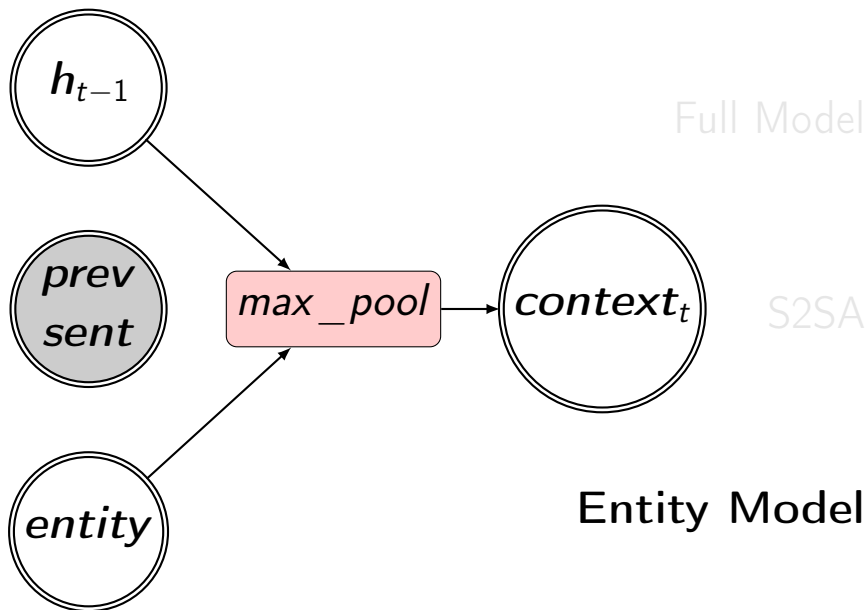
COMBINING THE CONTEXT REPRESENTATIONS



COMBINING THE CONTEXT REPRESENTATIONS



COMBINING THE CONTEXT REPRESENTATIONS



- Toronto Book Corpus: Adventure books
- 390 books split into 42,000 segments
- 43 million tokens, 35,000 types
- Annotations from Stanford CoreNLP

Zhu et al. (2015)

Clark and Manning (2016a,b)

EVALUATION #1: MENTION GENERATION

Passage:

All of a sudden, _____ walked
towards _____.

_____ yelled at _____ to get
back but _____ ...

Candidates:

[Emily]₁ (gold)

EVALUATION #1: MENTION GENERATION

Passage:

All of a sudden, [Emily]₁ walked
towards _____.
_____ yelled at _____ to get
back but _____ ...

Candidates:

[Emily]₁

[the dragon]₂ (gold)

EVALUATION #1: MENTION GENERATION

Passage:

All of a sudden, [Emily]₁ walked
towards [the dragon]₂.
_____ yelled at _____ to get
back but _____ ...

Candidates:

[Emily]₁

[the dragon]₂

[Seth]₃ (gold)

EVALUATION #1: MENTION GENERATION

Passage:

All of a sudden, [Emily]₁ walked towards [the dragon]₂.

[Seth]₃ yelled at _____ to get back but _____ ...

Candidates:

[Emily]₁

[the dragon]₂

[Seth]₃

[her]₁ (gold)

EVALUATION #1: MENTION GENERATION

Passage:

All of a sudden, [Emily]₁ walked towards [the dragon]₂.

[Seth]₃ yelled at [her]₁ to get back but _____ ...

Candidates:

[Emily]₁

[the dragon]₂

[Seth]₃

[her]₁

[she]₁ (gold)

EVALUATION #1: MENTION GENERATION

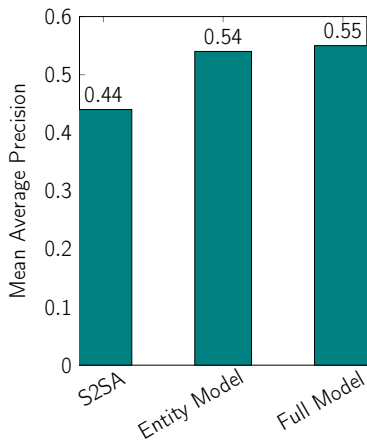
Passage:

All of a sudden, [Emily]₁ walked towards [the dragon]₂. [Seth]₃ yelled at [her]₁ to get back but _____ ...

Candidates:

[Emily]₁
[the dragon]₂
[Seth]₃
[her]₁
[she]₁ (gold)

Mention Generation



EVALUATION #2: SENTENCE SELECTION

Context:

... All of a sudden, [Emily]₁ walked towards [the dragon]₂.

Gold sentence:

[Seth]₃ yelled at [her]₁ to get back but [she]₁ ignored [him]₃.

Distractor sentence:

[She]₁ patted [its head]₄ and [it]₂ curled up outside [the cave]₅.

EVALUATION #2: SENTENCE SELECTION

Context:

... All of a sudden, [Emily]₁ walked towards [the dragon]₂.

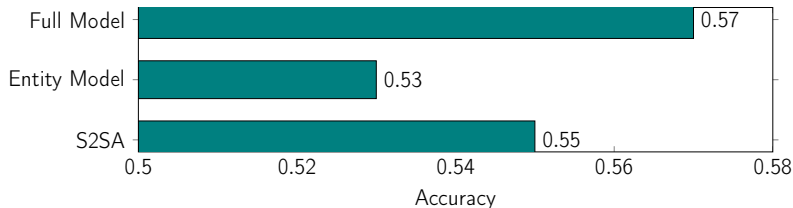
Gold sentence:

[Seth]₃ yelled at [her]₁ to get back but [she]₁ ignored [him]₃.

Distractor sentence:

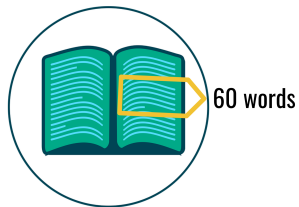
[She]₁ patted [its head]₄ and [it]₂ curled up outside [the cave]₅.

Sentence Selection Accuracy



EVALUATION #3: HUMAN EVALUATION

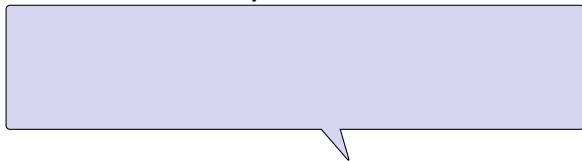
Context



Full Model

S2SA Model

Explanation



EVALUATION #3: HUMAN EVALUATION

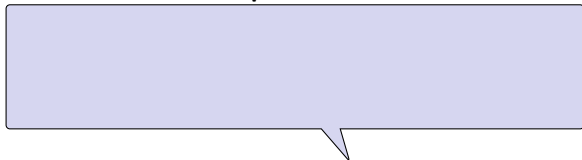
Context



Full Model
27 passages

S2SA Model
23 passages

Explanation



EVALUATION #3: HUMAN EVALUATION

Context

Scared of us hoodlums, they are. Like we ever would touch 'em," and he spat on the pavement. "The big city gang go where we want, when we want, no stopping us," he stated proudly.

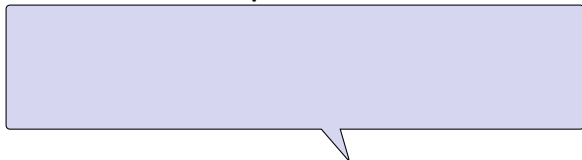
"These people here are all just sheep.

Baa, baa, one after the other.

Full Model

S2SA Model

Explanation



EVALUATION #3: HUMAN EVALUATION

Context

Scared of us hoodlums, they are. Like we ever would touch 'em," and he spat on the pavement. "The big city gang go where we want, when we want, no stopping us," he stated proudly.

"These people here are all just sheep.

Baa, baa, one after the other.

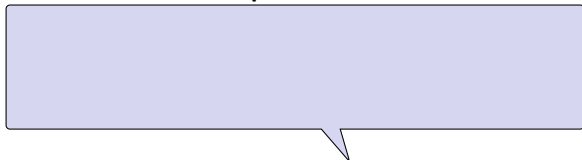
Full Model

There is nothing I can do."

S2SA Model

She didn't know what happened

Explanation



EVALUATION #3: HUMAN EVALUATION

Context

Scared of us hoodlums, they are. Like we ever would touch 'em," and he spat on the pavement. "The big city gang go where we want, when we want, no stopping us," he stated proudly.

"These people here are all just sheep.

Baa, baa, one after the other.

Full Model

There is nothing I can do."

S2SA Model

She didn't know what happened

Explanation

" 'She' isn't mentioned in the paragraph."

EVALUATION #3: HUMAN EVALUATION

Context

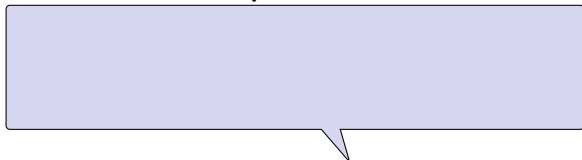
He was wearing brown slacks and a tan button-down shirt, with wool slippers. He looked about sixty, a little paunchy, with balding brown hair and a bushy mustache. Ice blue eyes observed Alejo keenly, then drifted over to Wara.

“Welcome to my home.” The man’s voice was deep and calm.

Full Model

S2SA Model

Explanation



EVALUATION #3: HUMAN EVALUATION

Context

He was wearing brown slacks and a tan button-down shirt, with wool slippers. He looked about sixty, a little paunchy, with balding brown hair and a bushy mustache. Ice blue eyes observed Alejo keenly, then drifted over to Wara.

“Welcome to my home.” The man’s voice was deep and calm.

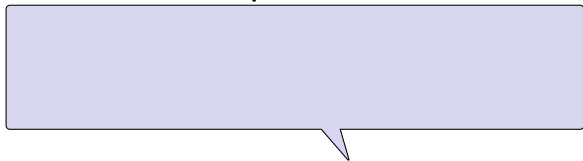
Full Model

“I’m proud of you,” he said.

S2SA Model

“What’s going on ?”

Explanation



EVALUATION #3: HUMAN EVALUATION

Context

He was wearing brown slacks and a tan button-down shirt, with wool slippers. He looked about sixty, a little paunchy, with balding brown hair and a bushy mustache. Ice blue eyes observed Alejo keenly, then drifted over to Wara.

“Welcome to my home.” The man’s voice was deep and calm.

Full Model

“I’m proud of you,” he said.

S2SA Model

“What’s going on ?”

Explanation

“The introduction makes the man sound like he is a stranger, so ‘I’m proud of you’ seems out of place.”

FUTURE DIRECTIONS

- Deeper entity knowledge: social commonsense, modeling inter-entity relationships
- Structure in story generation: discourse structure, semantics, story structure
- New domains: news articles, recipes

Rashkin et al. (2018)

Bosselut et al. (2018)

THANK YOU!

Questions?

eaclark7@cs.washington.edu



REFERENCES

- Bosselut, A., Levy, O., Holtzman, A., Ennis, C., Fox, D., and Choi, Y. (2018). Simulating action dynamics with neural process networks. In *ICLR*.
- Clark, E., Ross, A. S., Tan, C., Ji, Y., and Smith, N. A. (2018). Creative writing with a machine in the loop: Case studies on slogans and stories. In *IUI*.
- Clark, K. and Manning, C. D. (2016a). Deep reinforcement learning for mention-ranking coreference models. In *EMNLP*.
- Clark, K. and Manning, C. D. (2016b). Improving coreference resolution by learning entity-level distributed representations. In *ACL*.
- Grosz, B. J., Weinstein, S., and Joshi, A. K. (1995). Centering: A framework for modeling the local coherence of discourse. *Computational Linguistics*, 21(2):203–225.
- Hobbs, J. R. (1979). Coherence and coreference. *Cognitive Science*, 3:67–90.
- Ji, Y., Tan, C., Martschat, S., Choi, Y., and Smith, N. A. (2017). Dynamic entity representations in neural language models. In *EMNLP*.
- Rashkin, H., Bosselut, A., Sap, M., Knight, K., and Choi, Y. (2018). Modeling naive psychology of characters in simple commonsense stories. In *ACL*.
- Zhu, Y., Kiros, R., Zemel, R. S., Salakhutdinov, R., Urtasun, R., Torralba, A., and Fidler, S. (2015). Aligning books and movies: Towards story-like visual explanations by watching movies and reading books. In *ICCV*.