

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

Seattle, WA, USA

`{eac Clark7, yangfeng, nasmith}@cs.washington.edu`

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presenter: sun

MOTIVATION

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

Current Sentence: Seth yelled at her to get back but

MOTIVATION

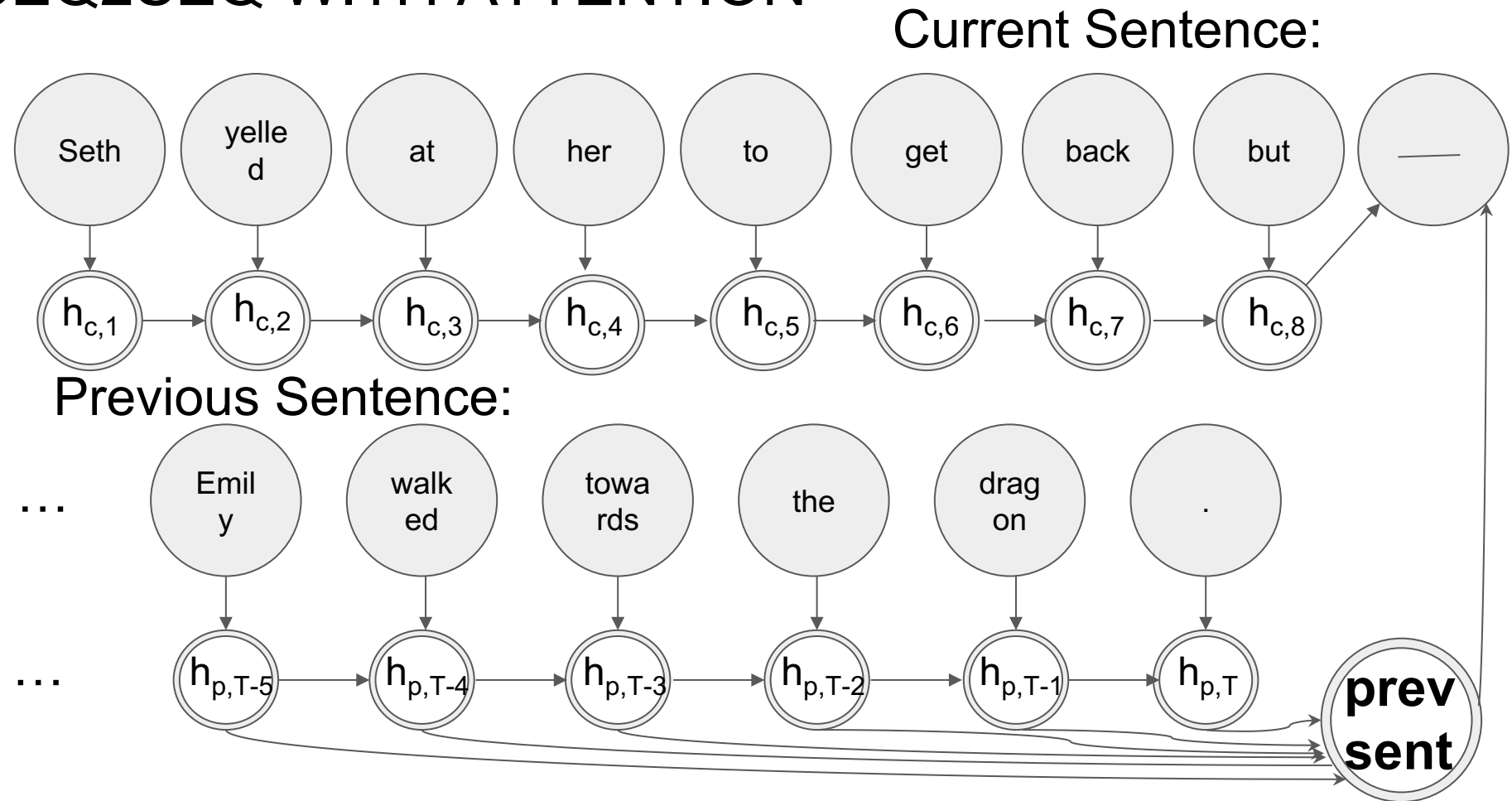
Context: All of a sudden, [Emily]₁ walked towards [the dragon]₂.

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

OVERVIEW

- ❑ 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



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.

“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:

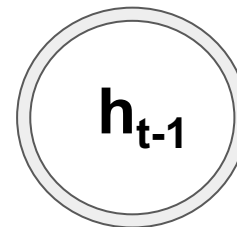
✓ [she]₁ ignored [him]₃

Option B:

✗ [Emily]₁ ignored [Seth]₃

THREE FORMS OF CONTEXT

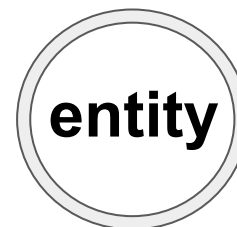
The current sentence



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 _____

ENTITY REPRESENTATIONS



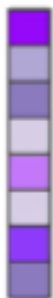
Context:

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

Current Sentence:

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

ENTITY REPRESENTATIONS



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ENTITY REPRESENTATIONS



Context:

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ENTITY REPRESENTATIONS



Context:

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

Current Sentence:

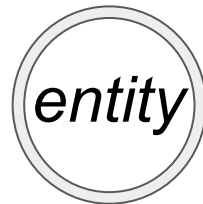
[Seth]₃ yelled at [her]₁ to get back but _____



GENERATE STORY WITH ENTITY

The model needs to make a couple of decisions:

- ❑ should next word in the story be an entity
- ❑ If so, which entity it refers to
 - ❑ entities previously mentioned in the story
 - ❑ introduce a new entity: initialize a new vector and add it into entity collection and update along with others.



VARIABLES AND REPRESENTATIONS

- R_t : binary random variable that indicates whether x_t belongs to an entity mention ($R_t=1$) or not ($R_t=0$)
- $L_t \in \{1, \dots, \ell_{max}\}$ is a random variable if $R_t=1$, which indicates the number of remaining words in this mention. ℓ_{max} is a predefined maximum length fixed to be 25. If $R_t=0$, then $L_t=1$.
- $E_t \in \mathcal{E}_t$ is the index of the entity referred to if $R_t=1$. It is the indices of all previously mentioned entities plus an additional value for a new entity.

(Dynamic Entity Representations in Neural Language Models, Ji, et.al, 2017)

GENERATE STORY

1. If $\ell_{t-1} = 1$ (i.e., x_t is *not* continuing an already-started entity mention):

- Choose r_t (Equation 3).
- If $r_t = 0$, set $\ell_t = 1$ and $e_t = \emptyset$; then go to step 3. Otherwise:
 - If there is no embedding for the new candidate entity with index $1 + \max_{t' < t} e_{t'}$, create one following §2.4.
 - Select the entity e_t from $\{1, \dots, 1 + \max_{t' < t} e_{t'}\}$ (Equation 4).
 - Set $\mathbf{e}_{current} = \mathbf{e}_{e_t, t-1}$, which is the entity embedding of e_t before timestep t .
 - Select the length of the mention, ℓ_t (Equation 5).

2. Otherwise,

- Set $\ell_t = \ell_{t-1} - 1$, $r_t = r_{t-1}$, $e_t = e_{t-1}$.

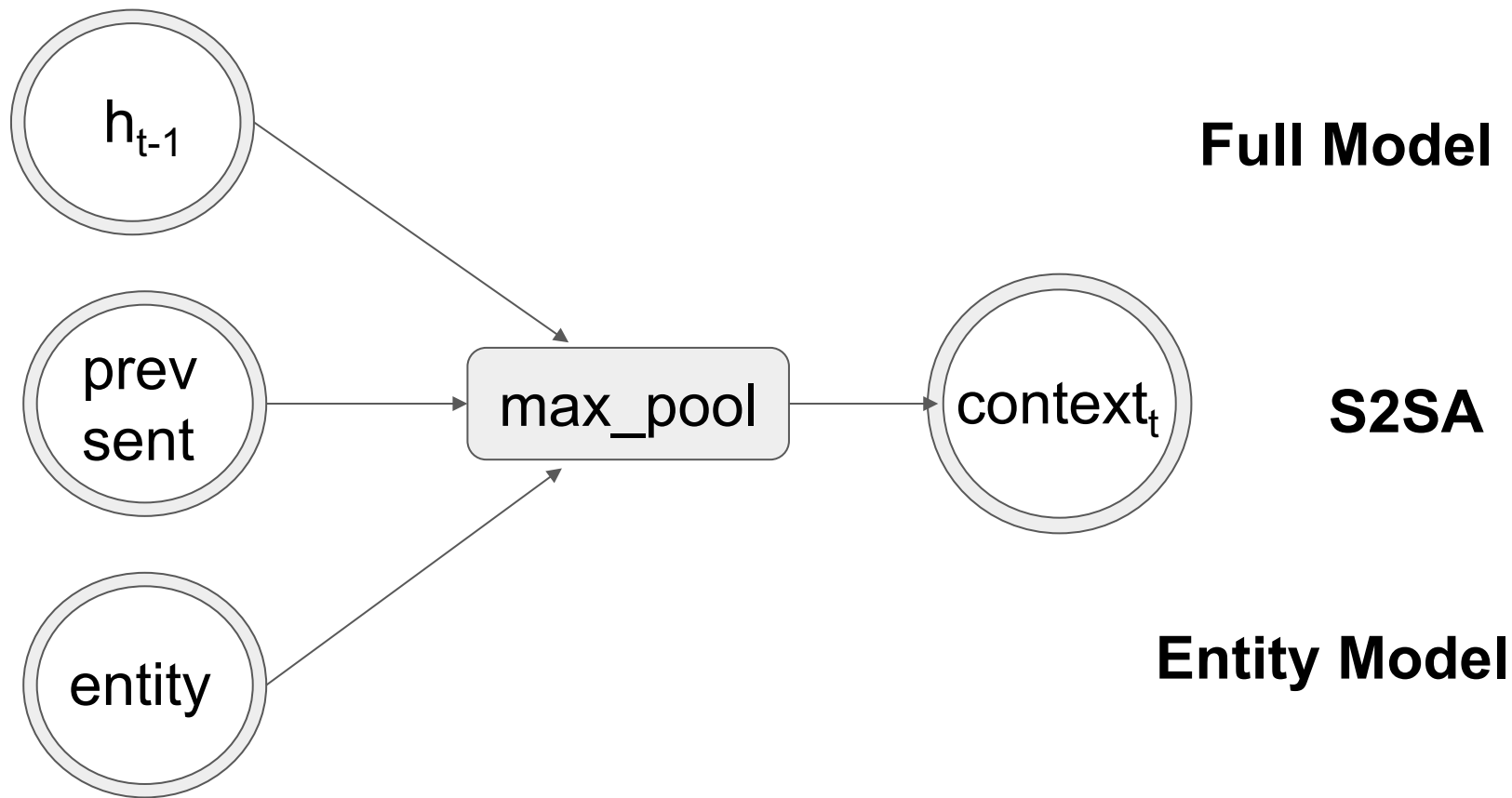
3. Sample x_t from the word distribution given the LSTM hidden state \mathbf{h}_{t-1} and the current (or most recent) entity embedding $\mathbf{e}_{current}$ (Equation 6). (If $r_t = 0$, then $\mathbf{e}_{current}$ still represents the most recently mentioned entity.)

4. Advance the RNN, i.e., feed it the word vector \mathbf{x}_t to compute \mathbf{h}_t (Equation 2).

5. If $r_t = 1$, update $\mathbf{e}_{e_t, t}$ using $\mathbf{e}_{e_t, t-1}$ and \mathbf{h}_t , then set $\mathbf{e}_{current} = \mathbf{e}_{e_t, t}$. Details of the entity updating are given in §2.4.

6. For every entity $e_i \in \mathcal{E}_t \setminus \{e_t\}$, set $\mathbf{e}_{i, t} = \mathbf{e}_{i, t-1}$ (i.e., no changes to other entities' representations).

COMBINING THE CONTEXT REPRESENTATIONS



CORPUS

- ❑ 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
- [the dragon]₂
- [Seth]₃
- [her]₁
- [she]₁

cluster and mention	cluster only	mention only
[Emily] ₁	*EMILY	Emily
[the dragon] ₂	THE DRAGON	the dragon
[Seth] ₃	SETH	Seth
[her] ₁		her
*[she] ₁		*she

Figure 2: Candidate lists for each of the mention generation tasks for completing the blank in Figure 1. The asterisk (*) indicates the correct choice.

EVALUATION #1: MENTION GENERATION

model	cluster and mention	cluster only	mention only
1. Reverse order	0.12	0.38	0.15
2. S2SA	—	—	0.44
3. ENTITYNLM	0.52	0.46	0.54
4. ENGEN	0.53	0.46	0.55

Reverse order: ranks mentions by recency

(the first element in the rank is the most recent mention)

- ❑ line 1 shows distance alone is not an effective heuristic for this task.
- ❑ line 2&4 shows the benefit of adding entity representations.
- ❑ line 3&4 shows local context also gives a small boost.

EVALUATION #2: SENTENCE SELECTION

Context:

$n - 1 = 49$ sentences

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

Gold sentence:

the n th (50th) sentences

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

Distractor sentence:

randomly chosen from
the next 50 sentences

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

EVALUATION #2: SENTENCE SELECTION

The distractor:

- ❑ come from the same story
 - ❑ with similar language, characters, and topic
- ❑ relatively nearby
 - ❑ in 2% cases, the very next sentence

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

1. [Seth]₃ yelled at [her]₁ to get back but [she]₁ ignored [him]₃.
 2. [She]₁ patted [its head]₄ and [it]₂ curled up outside [the cave]₅.
 3. “[Emily]₁, how did [you]₁ keep [that dragon]₂ from attacking [us]₆?”
-

Figure 3: A passage’s last sentence of context, and 3 sentences from various points in the next passage.

EVALUATION #2: SENTENCE SELECTION

model	mean accuracy	s.d.
1. S2SA	0.546	0.01
2. ENTITYNLM	0.534	0.006
3. ENGEN	*0.566	0.008

* significantly better than lines 1 and 2 with $p < 0.05$.

- ❑ ENGEN is better than the other two models.
- ❑ S2SA is better than EntityNLM: shows the importance of local context

EVALUATION #3: HUMAN EVALUATION

Context



60 words

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 pang 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

“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 ”

CONCLUSION

Propose a neural model for text generation that incorporates context via entities.

- ❑ mention generation
- ❑ sentence selection
- ❑ human evaluation