By the Community & For the Community: A Deep Learning Approach to Assist Collaborative Editing in Q&A Sites

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Background

Collaborative edits

- **Collaborative editing** is the editing of groups producing works together through individual contributions. Effective choices in group awareness, participation, and coordination are critical to successful collaborative writing outcomes.

- Widely used for crowd-sourcing websites or collaborative platforms:
  - Wikipedia
  - Google Doc, GitHub
Background

Collaborative edits in Stack Overflow

• Stack Overflow
  • 17M questions, 26M answers, 9.6M users
  • 7K new questions/day, many new users

• Edits:
  • [https://stackoverflow.com/help/privileges/edit](https://stackoverflow.com/help/privileges/edit)

  **What is edit questions and answers?**

  We believe in the power of community editing. That means once you’ve generated enough reputation, we trust you to edit *anything* in the system without it going through peer review. Not just your posts—*anyone’s posts*!

  **When should I edit posts?**

  Any time you feel you can make the post better, and are inclined to do so. Editing is encouraged!

  Some common reasons to edit are:
  • to fix grammatical or spelling mistakes
  • to clarify the meaning of a post without changing it
  • to correct minor mistakes or add addendums / updates as the post ages
  • to add related resources or hyperlinks
Observation

Community collaborative edits

- 21,759,565 edits before Dec 2017
  - 1,857,568 (9%) question-title edits
  - 2,622,955 (12%) question-tag edits
  - 17,279,042 (79%) post-body edits
Observation

What has been edited

• Edit type
  • Title, tag and post body

• Edit content
  • [https://stackoverflow.com/help/privileges/edit](https://stackoverflow.com/help/privileges/edit)
  • Formatting, spelling, grammar, readability
Observation

What is the scale of changes that post edits involve

• Calculate the change scale
  • character-level Longest Common Subsequence (LCS)

• Similarity
  • 71.29% post body edits are with similarity score between 0.8 and 1
  • 64.47% post body edits are with similarity score between 0.8 and 1

\[
similarity(original, edited) = \frac{2 \times N_{match}}{N_{total}}
\]
Goal

Assist or even automate collaborative edits

• Develop a tool for reminding users about the potential edits
  • Minor revision: many posts edits are about spelling, formatting, grammar ...
  • Sentence-level: most minor revision happen in single sentences.
Data Collection

Collecting the dataset of <original-post, post-body-edit-type>

- Regular expression and text differencing
- 13,806,188 sentence pairs
Method

- Data collection
  - 7,545,979 original-edited sentence pairs
- Edit model
  - Char-level seq2seq
  - Copy domain-specific word
Method

Character-Level RNN Encoder-Decoder Model

• Basic RNN model

• Char-based seq2seq
Method

Character-Level RNN Encoder-Decoder Model

• Copy domain-specific words
  • URL, API calls, variable names

Original: pls check https://docs.python.org/2/library/itertools.html#itertools.groupby for itertools.groupby() ...

Preprocess: pls check UNK_URL₁ for UNK_API₁...

Edited: Please check UNK_URL₁ for UNK_API₁...

Post-process: Please check https://docs.python.org/2/library/itertools.html#itertools.groupby for itertools.groupby() ...
Results

Performance comparison between our model and baselines

- Evaluation metrics
  - GLEU:
    \[
    \text{GLEU}(S, R, C) = BP \cdot \exp\left( \sum_{n=1}^{N} w_n \log p_n \right)
    \]

- Baseline
  - LanguageTools, Statistical Machine Translation (SMT)

<table>
<thead>
<tr>
<th>Method</th>
<th>GLEU</th>
</tr>
</thead>
<tbody>
<tr>
<td>RNN encoder-decoder</td>
<td>57.44</td>
</tr>
<tr>
<td>LanguageTools</td>
<td>51.93</td>
</tr>
<tr>
<td>SMT</td>
<td>46.85</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Original Sentence</th>
<th>Our RNN Encoder-Decoder</th>
<th>LanguageTool</th>
<th>Phrase-based SMT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 What did I wrong?</td>
<td>What did I wrong?</td>
<td>What I did wrong?</td>
<td></td>
</tr>
<tr>
<td>2 pls help me.</td>
<td>Please help me.</td>
<td>Please help me.</td>
<td></td>
</tr>
<tr>
<td>3 However you show use CSS for this.</td>
<td>However, you should use CSS for this.</td>
<td>However, you show use CSS for this.</td>
<td></td>
</tr>
<tr>
<td>4 I'm thinking it has something to do with the json.</td>
<td>I'm thinking it has something to do with the JSON.</td>
<td>I'm thinking it has something to do with the json.</td>
<td></td>
</tr>
<tr>
<td>5 Inside the li tag we have many options to select.</td>
<td>Inside the li tag we have many options to select.</td>
<td>Inside the li tag we have many options to select.</td>
<td></td>
</tr>
<tr>
<td>6 Here selectedShape is either circle or polygon.</td>
<td>Here selectedShape is either circle or polygon.</td>
<td>Here selectedShape is circle or polygon.</td>
<td></td>
</tr>
<tr>
<td>7 Edit: By the way, this is my first time using the community wiki.</td>
<td>Edit: By the way, this is my first time using the community wiki.</td>
<td>Edit: By the way, this is my first time using the community wiki.</td>
<td></td>
</tr>
<tr>
<td>8 It looks as if the large image is taking up all the space.</td>
<td>It looks as if the large image is taking up all the space.</td>
<td>It looks as if the large image is taking up all the space.</td>
<td></td>
</tr>
<tr>
<td>9 Below the code I use to validate a user login outside magento.</td>
<td>Below the code I use to validate a user login outside magento.</td>
<td>Below the code I use to validate a user login outside magento.</td>
<td></td>
</tr>
<tr>
<td>10 How to find the library dependency?</td>
<td>How to find the library dependency?</td>
<td>How to find the library dependency?</td>
<td></td>
</tr>
</tbody>
</table>
Results

Further evaluation

• Influence by length
  • With the length increase, the baselines are comparable to our model

• Assist real edit
  • Within randomly selected 50 latest posts, our model recommend edits to 39 of them.
  • 36 edits (92.3%) are accepted, while 3 (7.7) rejected
Feedback from Real Users

• Survey
  • Q1: How much do you care about spelling, grammar, formatting edits?
  • Q2: What percentage of your edits are spelling, grammar, formatting edits?
  • Q3: How much could our tool help with such edits?

• Feedback
  • Send email to 410 users who ranked top 2000 in Stack Overflow
  • 61 valid replies
  • Other suggestions:
    • “SO needs this tool and I hope to see it in action soon. I believe the resulting tool might be useful outside the context of SO websites.”
    • “How will it get integrated with the SO site?”
    • “Not interested. Same reason I abhor spell and grammar checkers. Generally way too many false positives”