arXivEdits: Understanding the Human Revision Process in Scientific Writing

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Code/Data

1. Revisions in Scientific Writing

- Researchers devote **a huge amount of efforts** to revise their papers.
- **Valuable Knowledge** is Encoded.
  - Logical and structural improvement at doc.-level.
  - Stylistic and grammatical refinement at sent.-level.
- Source of revision: **two adjacent versions** of the same paper on arXiv.

Submission history
From: Ashish Vaswani [view email]
[v1] Mon, 12 Jun 2017 17:57:34 UTC (1,102 KB)
[v2] Mon, 19 Jun 2017 16:49:45 UTC (1,125 KB)
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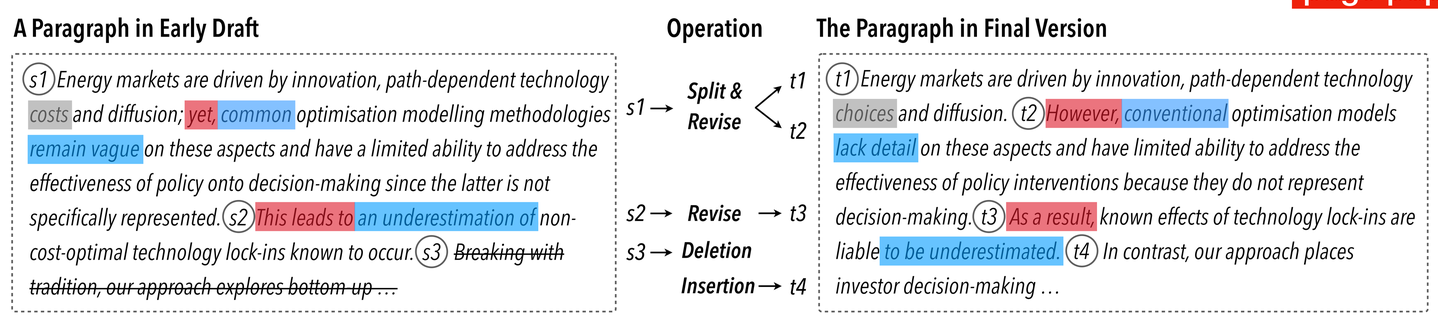
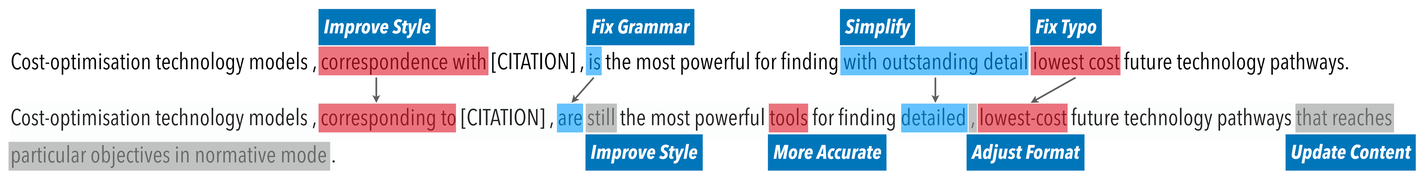
[v4] Fri, 30 Jun 2017 17:29:30 UTC (1,124 KB)
[v5] Wed, 6 Dec 2017 03:30:32 UTC (1,124 KB)

2. arXivEdits Corpus

- **Sentence alignment for 751 paper groups across 6 research areas in 23 years.** Full multi-page papers!



- **Fine-grained sentence level with intentions for 1,000 sentence pairs.**



- **An taxonomy for edit intention in the scientific writing domain.** New!

Intention	Definition	%
Improve Language		28.6%
More Accurate/specific	Minor adjustment to improve the accuracy or specificness of the description.	11.5%
Improve Style	Make the text sound more professional or coherent without altering the meaning.	8.7%
Simplify	Simplify complex concepts or delete redundant content to improve readability.	7.6%
Other	Other language improvements that don't fall into the above categories.	0.8%
Correct Grammer/Typo	Fix grammatical errors, correct typos, or smooth out grammar needed by other changes.	25.4%
Update Content	Update large amount of scientific content, add or delete major fact.	28.8%
Adjust Format	Adjust table, figure, equation, reference, citation, and punctuation etc.	17.2%

3. An Automatic System

- **Task 1: Span-level Edit Extraction**
  - Baseline Prior work rely on diff algorithm to extract edits, which is based on minimizing edit distance **regardless of semantic meaning**.
  - We formulated it as span alignment task.
  - Our method can **extract more fine-grained and explainable edits**.
  - Word alignment models:
    - neural semi-CRF aligner. Our model @ACL2021!
    - QA-Align (Nagata et al., 2020).
  - Baseline: Latexdiff

	Perf. (P/ R /F1)				% of Edit Types			Len. of Edits		
	P	R	F1	EM	Ins.	Del.	Sub.	Ins.	Del.	Sub.
Semi-CRF Aligner	87.5	87.7	87.6	80.5	32.9	26.7	40.4	4.66	4.98	2.21
QA-Align	87.7	88.4	88.0	82.0	33.2	24.0	42.9	4.46	4.62	2.08
Latexdiff	76.2	74.3	75.3	70.0	26.2	14.4	59.3	3.89	4.27	4.73

Latexdiff treats everything as large chunk substitutions

- **Task 2: Automatic Sentence Alignment.**
  - A neural CRF word alignment model trained on our corpus achieves 93.8 F1. Our model @ACL2020!

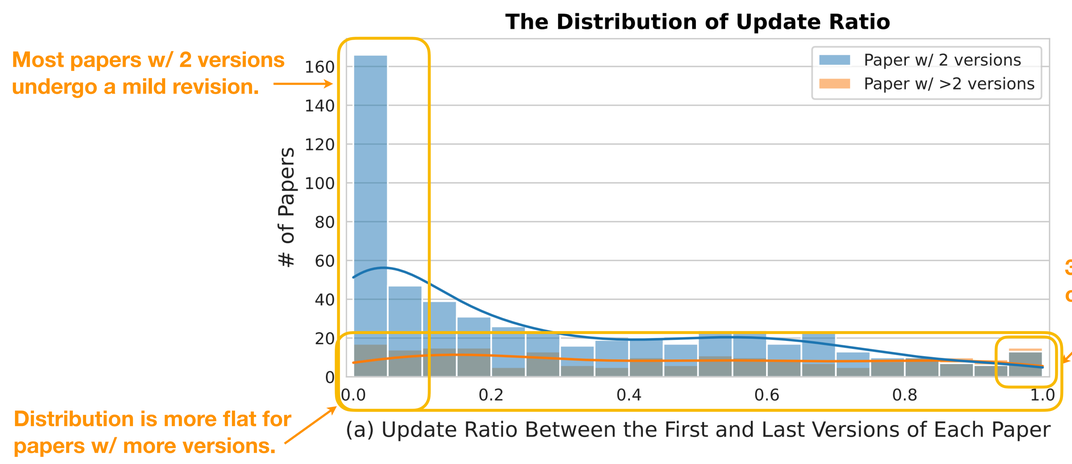
Methods	Precision	Recall	F1
Char. 3-gram (Štajner et al.)	87.7	87.7	87.7
TF-IDF (Paetzold et al.)	90.3	**91.6**	90.9
Jaccard (Xu et al.)	90.7	89.5	90.1
BLEU (Faruqui et al.)	89.9	89.6	89.8
Neural CRF aligner (ours)	**96.9**	91.0	**93.8**

- **Task 3: Intention Classification.**
  - The best Performing T5-large model achieves a 79.3 accuracy on fine-grained classification task.

Intention Label	Precision	Recall	F1
Adjust Format	96.7	94.6	95.6
Update Content	84.8	86.9	85.8
Fix Grammar/Typo	81.8	85.1	83.1
Language-Simplify	75.0	66.7	70.6
Language-Accurate	54.7	63.0	58.6
Language-style	46.9	37.5	41.7

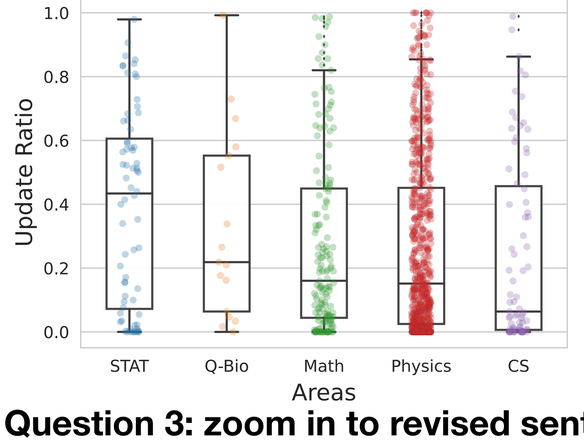
4. Analysis of Writing Strategies

- **Question 1: How much content been updated?** *Update Ratio Between V_i and V_j = 1 - $\frac{\#\ of\ kept\ sent.}{\#\ of\ all\ sent.\ in\ V_i}$*

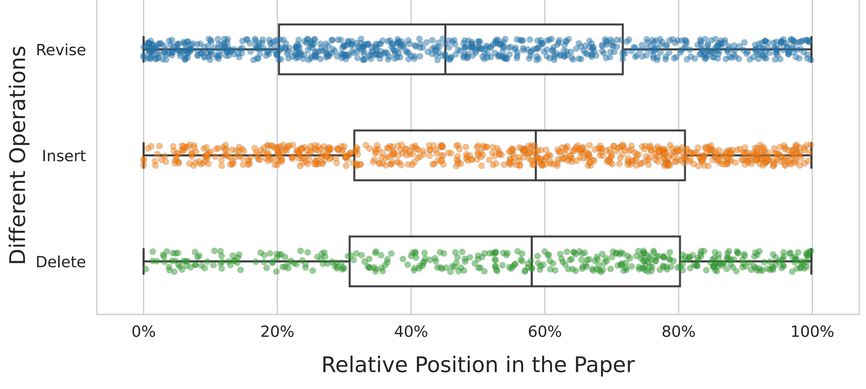


Please see more analysis in our paper!

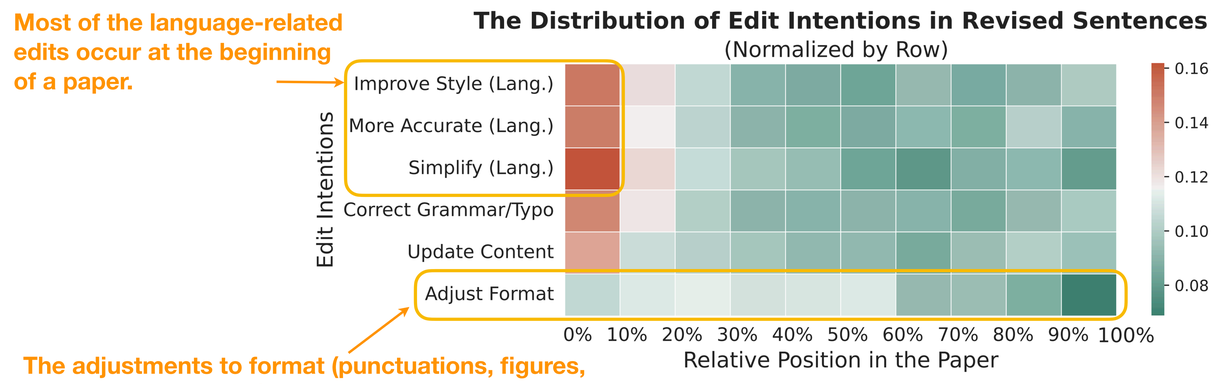
- **Question 2: Do researchers in all areas have same practice when revising papers?**
  - No. Researchers in STAT make more significant revisions compared to CS.



- **Question 3: Where do researchers revise their papers?**
  - More sentences at the beginning are edited.
  - The insertion and deletion of sentences occur more in the latter parts.



- **Question 3: zoom in to revised sentences, why do researchers make the span-level edits?**
  - Run our span-level edit extraction and intention classification modules on all the revised sentences.



5. Takeaways

- We provide **a complete computational framework** to study text revision in the scientific writing domain.
- **Answer "*What common strategies are used by authors to improve the writing of their papers?*"**
- **All techniques can be generalized to other domains!**