Error Analysis of Error Corrections in Machine Translation

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Workshop Errare 2013, Ermenonville, France

Machine Translation

1949

"Having had considerable exposure to computer design problems during the [Second World] war, and being aware of the speed, capacity, and logical flexibility possible in modern electronic computers, it was very natural for [Mr. Weaver] to think, several years ago, of the possibility that such computers be used for translation."

(Warren Weaver (1949). Translation.)

Machine Translation

1966

*"... when, after 8 years of work, the Georgetown University MT project tried to produce useful output in 1962, they had to resort to **post-editing**. The postedited translation took slightly **longer to do** and was **more expensive** than conventional human translation."*

(ALPAC (1966). Languages and machines: computers in translation and linguistics)

***Postediting** (or post-editing) "is the process of improving a machine-generated translation with a minimum of manual labour".*

(Wikipedia)

Post-editing

2013

- In recent years, MT has improved substantially in terms of quality, cost and availability.
- As a result, many LSPs have now started using MT as a support tool for human translation (post-editing).
- Some users are reporting impressive gains, at least for some application domains and language pairs.

Post-editing Data

- Post-editing has the potential of changing Machine Translation: post-edited translations can be seen as **annotated MT output**, which can be actively used.

> ~~the organization is~~ The authority has actually ~~sentenced~~ been ordered to ~~perform~~ carry out work that ~~he~~ has not been done since 1926 .

- Problem: Inter-annotator agreement [Wisniewski et al., 2013]

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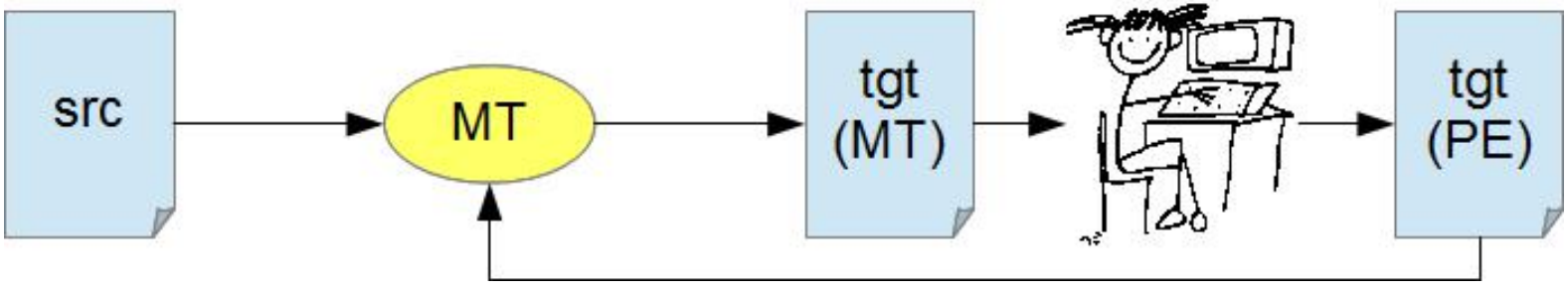
Post-editor Feedback

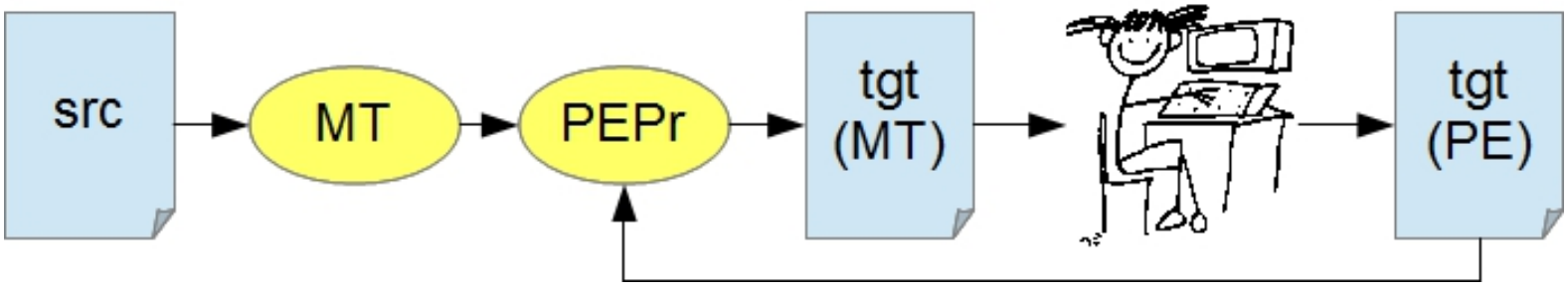
- Application for post-editing data: **improve MT**
- The real challenge: do this in **real-time**, as the post-editor is working.



- One approach: **learn the new translations**, i.e. feed post-edited translations back into the (Statistical) MT system [Nepveu et al., 2004, Levenberg et al., 2010, Hardt and Elming, 2010, Bertoldi et al., 2013]

Post-editor Feedback

- An alternative approach: **learn the corrections**, then perform **Post-edit Propagation** (*PEPr*):

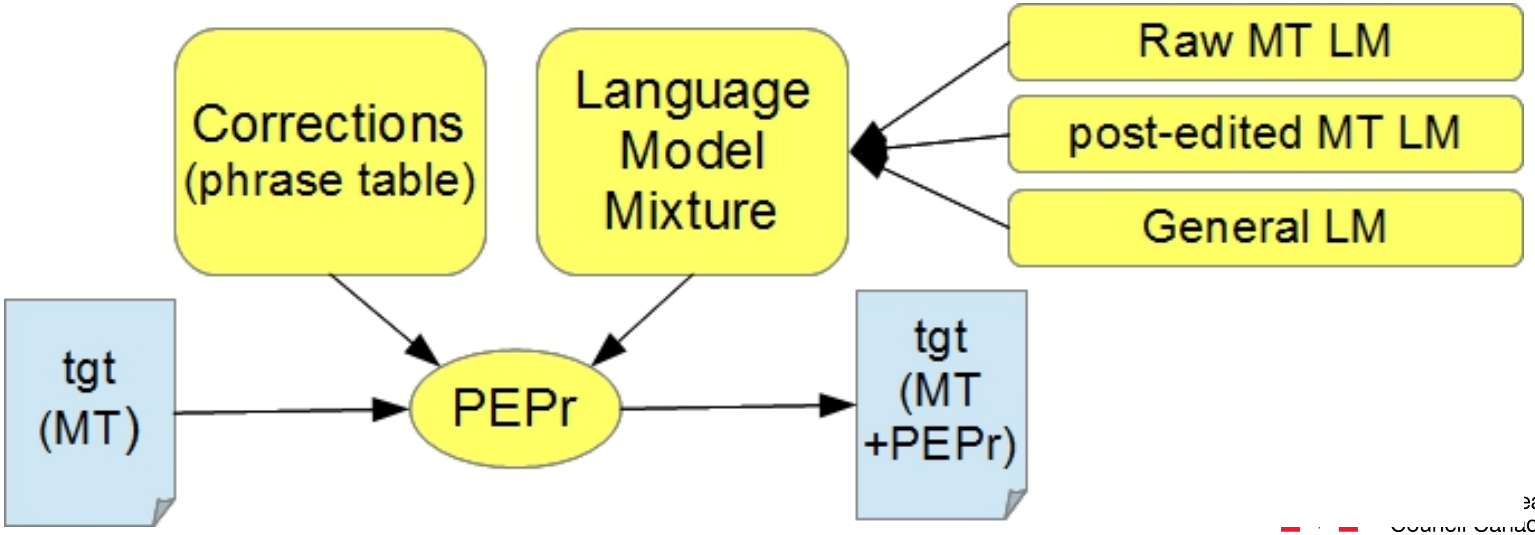


[Simard and Foster, 2013]

- Automatically analyse post-edits as they are produced
- Selectively re-apply learned corrections to further MT output

Post-edit Propagation

- The PEPr system is essentially a **phrase-based SMT** system, with incremental updates
- Learned corrections are stored into a **phrase-table**
- Corrections are performed through **decoding**
- Whether or not a correction is applied depends on its relative frequency and how it scores with the target-language model mixture.



Post-edit Propagation

Post-edited Data

~~the organization is~~ The authority has actually ~~sentenced~~ been ordered to ~~perform~~ carry out work that ~~he~~ has not been done since 1926 .

Learned Corrections

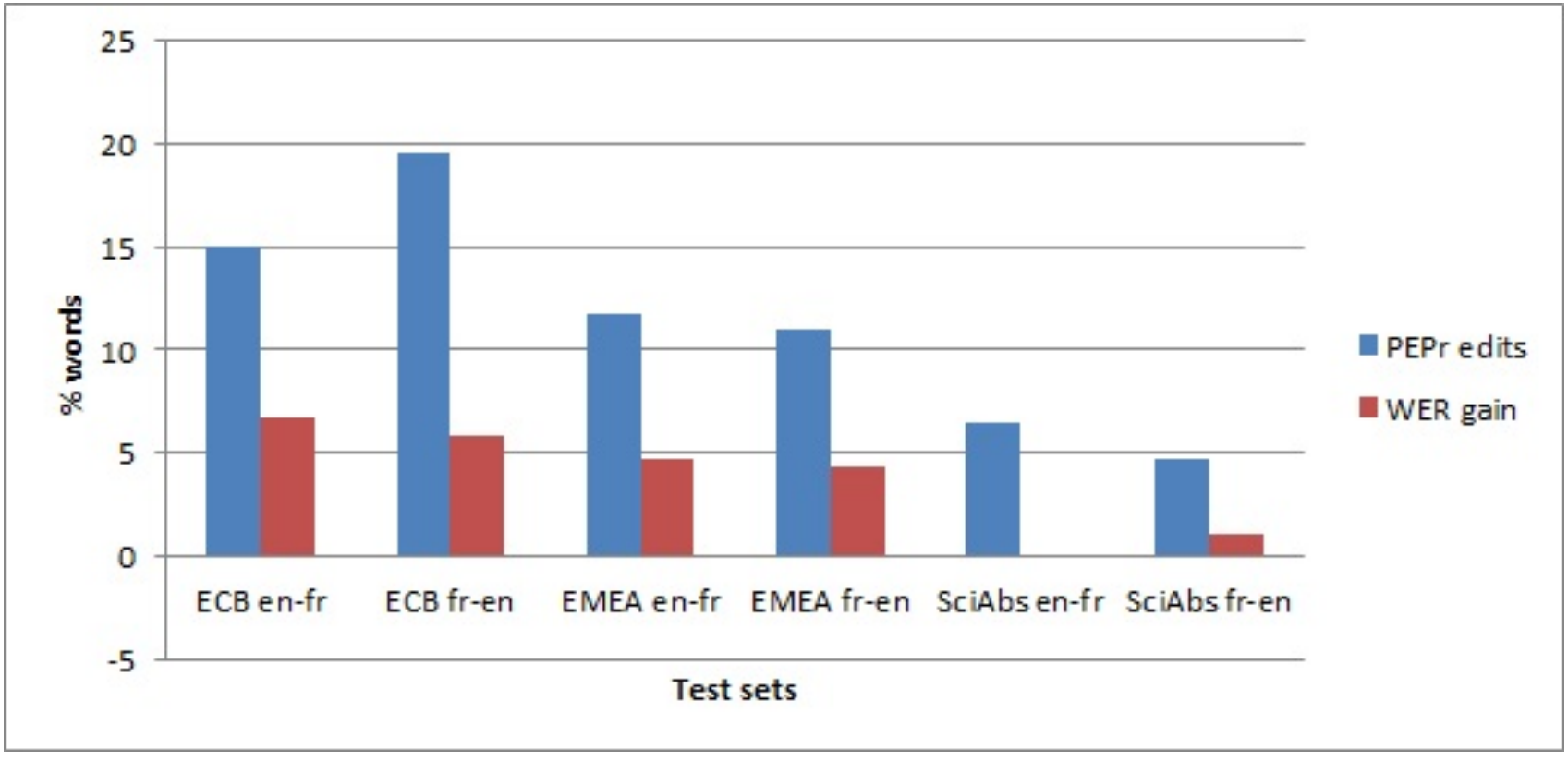
the	→	The
the organization	→	The authority
...		
is	→	has
is actually	→	has actually
...		
to perform work	→	to carry out work
...		
work that	→	work that
...		

Experimental Results

- Test Sets: collections of documents from existing bilingual corpora (*not real post-editing*): ECB, EMEA, Canadian Science Abstracts.
- Raw MT: General-purpose SMT system
- PEPr is effective for technical documents with at least some **internal repetition**.

		WER		PEPr edits
Corpus	Lang.	raw MT	MT + PEPr	(% words)
ECB	en→fr	67.76	61.06	15.06
	fr→en	67.35	61.51	19.54
EMEA	en→fr	67.25	62.60	11.77
	fr→en	59.95	55.57	10.97
Science	en→fr	63.00	63.08	6.42
Abstracts	fr→en	60.36	59.35	4.75

Error Analysis: PEPr gains vs. edits



Error Analysis

- Which corrections are more likely to be **beneficial**?
- Which corrections are **hurting** the most, and **why**?

emea_fr2en_port/test/doc-en_humandocs_PDFs_EPAR_Neorecormon_H-116-PI-en.xml.gz/seg-096					
Source:	Pendant toute la durée du traitement , l' hématocrite ne doit pas dépasser 48 % .				
MT	***PEPr***	***Reference***	***Lev***	***LCS***	***Len***
Throughout the duration of the	Throughout the duration of the	During the entire	+0	+0	+0
treatment ,	therapy ,	treatment	-1	-1	+0
hematocrit	occasions	period	+0	+0	+0
shall	should	, a PCV of 48 % should	+1	+1	+0
not exceed 48 % .	not exceed 48 % .	not be exceeded .	+0	+0	+0
		Total:	**+0**	**+0**	**+0**
		Global:	**+0**	**-1**	**+0**

Error Analysis

- Many PEPr errors are due to **bad alignments**, i.e. cases where our analysis of post-edits breaks down.
  $\rightarrow$ Better alignment methods might help
  $\rightarrow$ Maybe a better idea to **discard segments** that are too heavily post-edited.
- Some corrections don't generalize well:
  - agreement errors
  - function words
  - POS change
  - inserting/removing commas
  - etc.

  Errors that are **contextual** by nature.

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Future Work

- Devise rules-of-thumb for discarding corrections that are potentially bad
- More promising: **Confidence estimation** on individual corrections.
  - Corrections with low confidence can be excluded systematically
  - Alternatively, confidence scores can be used as a selection feature by the PEPr decoder

Thank you!

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