

Investigations on Large-Scale Lightly-Supervised Training for Statistical Machine Translation

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Introduction

Training of an SMT system

- Only bilingual sentence-aligned texts (“*bitexts*”) and large monolingual texts are needed
- An SMT system can be developed without the need of any language-specific expertise
- Monolingual data is usually available in large amounts
- But aligned bilingual texts are a sparse resource for many language pairs (too small, out-of-domain, ...)

Introduction

How to resolve the problem of insufficient bitexts ?

- Pay people to produce more bitexts
 - Integration of high quality dictionaries
 - Try to take better advantage of limited data (factored translation model, ...)
 - Get more bitexts from the Internet:
 - Most of the found bilingual texts are not direct translations of each other that can be easily aligned
 - = *comparable corpora*
(Wikipedia, international news agencies, ...)
 - How to exploit comparable corpora ?
- ⇒ Try to align some of the sentences
[Munteanu and Marcu CL'05, Resnik and Smith CL'03, ...]

Unsupervised Training of an SMT system

Our approach

- Build a baseline SMT system
(using a limited amount of bitext or out-of-domain)
- Use this system to translate large amounts of texts in the source language
- Build a new SMT system with these translations together with the source as additional bitexts
- **We don't need a comparable corpus,**
just texts in the source language

Variants

- Add related translations to the target LM
- ⇒ Light supervision using a comparable corpus
- How good should be the initial SMT system ?

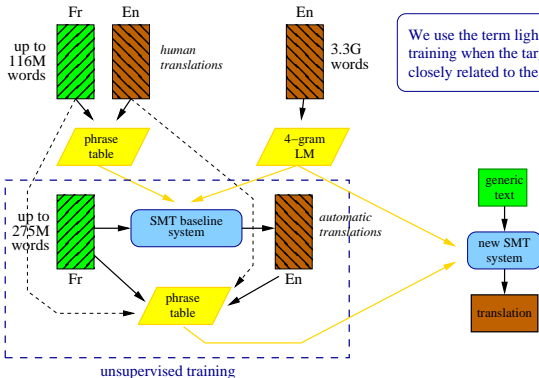
Unsupervised Training of an SMT system

Setup

- Try to build a generic news translation system (French \rightarrow English)
- Lightly-unsupervised training on LDC's Gigaword corpora:

corpus	#Words	
	French	English
AFP 199x	236M	132M
AFP 200x	337M	326M
<i>Europarl</i>	<i>40M</i>	<i>36M</i>

Principle of Lightly-Supervised Training



Unsupervised training for domain adaptation

- Several papers by Ueffing et al. [IWSLT'06, ACL'07]
 - translate **the test data**
 - compute confidence scores and filter the outputs
 - adapt the system (build small additional phrase table, ...)
- Work by Chen et al [ACL'08]

- Produce bitexts with a Rule-based system [Hu et al, EMNLP'07]

Baseline System (1)

- Based on the Moses toolkit

Dev and Test data

- Newstest2008 from WMT'08 evaluation
- Consists of news texts (politics, health, financial, society, music, ...) collected from the Internet
- Split randomly into Dev and Test set (about 1000 lines, 22k words each)
- Many spelling errors in the French translations were automatically corrected

Baseline System (2)

Available Bitexts

- News-commentary corpus (1.6M words),
- Europarl corpus (40.1M words),
- Canadian Hansard corpus (72.4M words).
- Bilingual dictionary from SYSTRAN (512k words).

Available LM data

- English part of bitexts
- UN data
- Full English Gigaword

Example Translations (1)

French source text:

- *La paix exige une direction palestinienne nouvelle et différente, afin que puisse naître un Etat palestinien. J'appelle le peuple palestinien à élire de nouveaux dirigeants, des dirigeants qui ne soient pas compromis avec le terrorisme.*

Automatic translations:

- *The peace requires a new and different Palestinian leadership, so that we can create a Palestinian state. I call on the Palestinian people to elect new leaders, leaders not compromised by terrorism.*

Example Translations (2)

French source text:

- *M. Arafat, qui s'est juré de faire de l'année 2000 celle de la proclamation d'un Etat palestinien, a mis un point d'honneur à recevoir les six chefs d'Etat présents.*

Automatic translations:

- *Mr. Arafat, who has vowed to make the year 2000 the proclamation of a Palestinian state, has made a point of honour to receive the six heads of state present.*

Example Translations (3)

French source text:

- *Trois heures après, c'était au tour de la Colombie britannique et de Vancouver de célébrer l'arrivée de l'an nouveau.*

Automatic translations:

- *Three hours later, it was the turn of the British Columbia and Vancouver célébrer the arrival of the new year.*

Performance of Baseline Systems

Bitexts	Dict.	Words	Dev	Test
Big SMT system				
News-commentary + Eparl + Hansard	+	116M	22.69	22.17

Performance of Baseline Systems

Bitexts	Dict.	Words	Dev	Test
Big SMT system				
News-commentary + Eparl + Hansard	+	116M	22.69	22.17
Small SMT system				
News-commentary	+	2.4M	20.44	20.18
News-commentary	-	1.6M	19.41	19.53
News-commentary + Eparl	+	43.3M	22.27	22.35

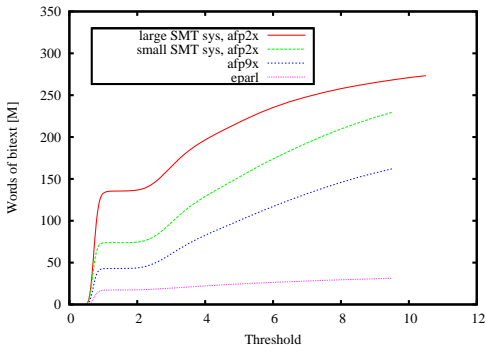
The big SMT system was ranked best in the 2008 WMT evaluation

Some Comments on the Dictionary

- Provides nouns in singular and plural
 - Verbs and in all tenses, ...
 - These dictionary entries were directly added to the bitexts
 - Can potentially improve the other alignments
 - Words appearing only in the dictionary have bad translation probabilities
- ⇒ We hope to improve these probabilities by lightly-supervised training
- Many of the dictionary entries are likely to appear in the large monolingual texts

Filtering the Automatic Translations

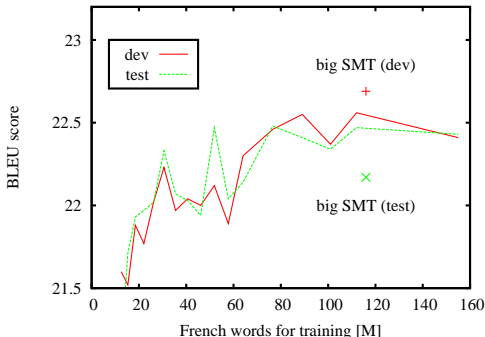
- Try to discard the bad translations
- Some are tables or enumerations of names, places, ...
- We just used the normalized sentence likelihood



⇒ Use up to 150M words of automatic translations

Using the large SMT Baseline System

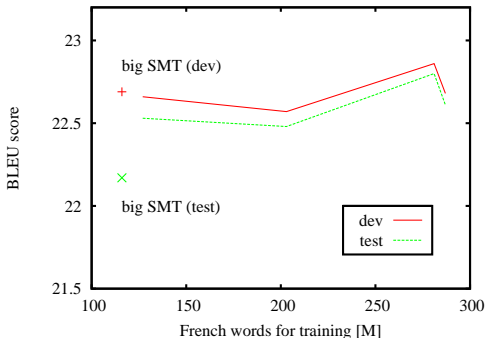
- Build SMT system **with automatic translations only**



- Better than the baseline when using more than 70M words
- Seems to generalize better
- Improved translation probabilities for dictionary words ?

Using the large SMT Baseline System

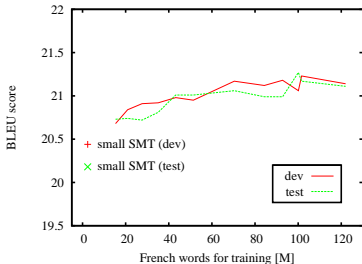
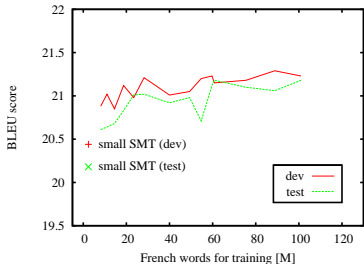
- Build SMT system with **all human and automatic transl.**



- Mainly improves performance on Test data
- Fortunate peak when using a total of 280M words of bitexts: +0.6 BLEU on Test

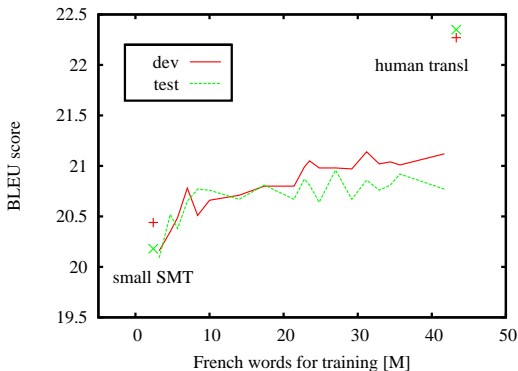
Using the small SMT Baseline System

Build SMT system with human-provided and translations of
 afp9x
 afp2x



- Best performance on Dev for a total of about 100M words
 - BLEU on Test set is 21.2 (+1 point)
- ⇒ iterate the process ?

Retranslating Europarl



- Automatic translations of Europarl seem to be less useful than Gigaword data
- Comparison to the reference translations: third of the improvement with 70% of the data

Conclusions

- Translated up to 300M words from Gigaword news texts from French to English
- Automatic translation directly used as additional bitexts (after simple filtering)
- First application of large-scale lightly-supervised training to SMT
- Improvements in the BLEU score:
 - +0.6 on top of state-of-the-art system
 - +1.1 on top of small SMT system (2.4M words of bitexts)
- Seems to improve generalization behavior
- Method to obtain translation probabilities for dictionary words
- Used several thousands of hours of compute time

Perspectives

- Use a biased LM (with comparable corpora)
- Verify approach when no related texts in the target language are available
- More sophisticated techniques to filter the translations
- Iterate procedure and incrementally improve the system ?
- Compare and combine with IR techniques to extract parallel sentences
- Other language pairs

Result Summary

Bitexts Human-provided		Lightly-supervised	Total Words	BLEU score		Ptable Size	
				Dev	Test		
Nw+dict	2.4M		2.4M	20.44	20.18	5M	
Nw+Ep+dict	43M	-	43.3M	22.17	22.35	83M	
Nw+Ep+Hans+dict	116M		116M	22.69	22.17	213M	
Translated with the small SMT system:							
News	2.4M	afp9x	28M	2.4M	21.21	21.02	58M
			101M	2.4M	21.23	21.18	189M
		afp2x	43M	2.4M	20.98	21.01	77M
			102M	2.4M	21.23	21.17	170M
		Eparl	7M	2.4M	20.78	20.65	17M
			31M	2.4M	21.14	20.86	67M
Translated with the big SMT system:							
		afp2x	31M	31M	22.23	22.33	55M
			112M	112M	22.56	22.47	180M
News+Eparl	42M	afp2x	77M	129M	22.65	22.44	203M
	42M		155M	197M	22.53	22.73	320M
News+Eparl+Hans	114M	afp2x	167M	281M	22.86	22.80	464M