Comparison of MT between related and unrelated languages

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http://ufallab2.ms.mff.cuni.cz/~bojar/teaching/NPFL087/wiki/CzeRu

machine translation

in our experiment

- a system of programs
- takes text (natural language) as input, also needs models
- outputs text translated into another language
- poor quality – Does it worth reading?

different approaches

- data driven
  - word to word
  - phrase based
  - example based, employing syntax, ...
- manualy constructed translation rules, ...

phrase based machine translation – simplified idea

training/learning

- explores paralel bilingual corpus – a list of 1:1 coupled sentences
- a phrase is a continuous sequence of tokens (for our purposes)
- extracts a list of (scored) equivalent phrases
- how phrases are extracted is not explained here

- also explores monolingual (target side) corpus to train language model
- simplified: lists of words with zero, one and two previous words

phrase based machine translation – simplified idea (2)

decoding/search for translation

- try to cover an input sentence with source-side of learned phrases
- target-side of selected phrases forms output sentence
- search is driven by phrase score and language model

- phrase model ensures translation correspondence
- language model tends to make output sentenge grammatical

achieved abstraction

- phrases over sentences

phrase based machine translation – main issues

achieved abstraction

- phrases over sentences
- but no further generelization
- cannot even recognize an unseen form of a seen word in the language model

data sparseness

- in any available corpus we do not see all usages of all units (words)
- but we would like to se all translations in all their contexts in source language
- thus generalization is needed

Example

EBMT: close to mountains → close to X

generalization in language model

n-gram language model

- n-gram is n-tupple of tokens; e.g. $n = 2$
  w|h: řekla|⊘ ,|řekla že|, půjde|že s|půjde námi|s .|námi
- a sentence is scored on the basis of scores of n-grams it consists of (Bayes' chain rule)
- usually n=3, 2 tokens of history, 1 predicted:
  $p(w_i|w_{i-2}w_{i-1})$
- higher n $\rightarrow$ suffering more from data sparseness
- take into account also m-grams, $0 \leq m < n$ (smoothing)

smoothing with parts of speech

- if we have not seen the word in a given context of words, use at least the context of its POS
- $p(\text{lesy}|\text{rozsáhlé}) = \cdots + \lambda_i p(\text{lesy}|\text{Adj.}) + \cdots$

Statistical Machine Translation between Czech, Russian and English

Carried out experiments' basic facts

- employed data set: UMC 0.1 + extra set from ProjectSyndicate
- direction of translations: ru $\rightarrow$ cz, en $\rightarrow$ cz
- included methods: direct transfer, factored translation, both using Moses and related tools
- evaluation: Bleu, Gray-box evaluation

Data sources

Corus UMC 0.1

- Ufal Multilingual Corpus
- ProjectSyndicate articles new in 2009
  extra 2 765 sentences tri-parallel
- numbers

LM sencences	cz	92 233
TM sencences	ru $\rightarrow$ cz	79 888
TM sencences	en $\rightarrow$ cz	76 588
test set	cz, en, ru	1 000
dev set	cz, en, ru	750

Main steps

Data preparation

- factored TM training corpus
  - lemmatization and tagging
  - English&Russian by Tree-Tagger
  - Czech by J. Hajič tagger module in TectoMT
  - a lot of exercises with UNIX tools :-)

Factored sentence snippets

prostě|prostě|Dg-----1A---- jsem|být|VB-S-1P-AA---
включая|включая|Sp-a президента|президент|Ncmsay
мбеки|мбеки|Vmip3s-a-p
the|the|DT visionaries|visionary|NNS would|would|MD
have|have|VH gotten|get|VVN nowhere|nowhere|RB

Main steps (2)

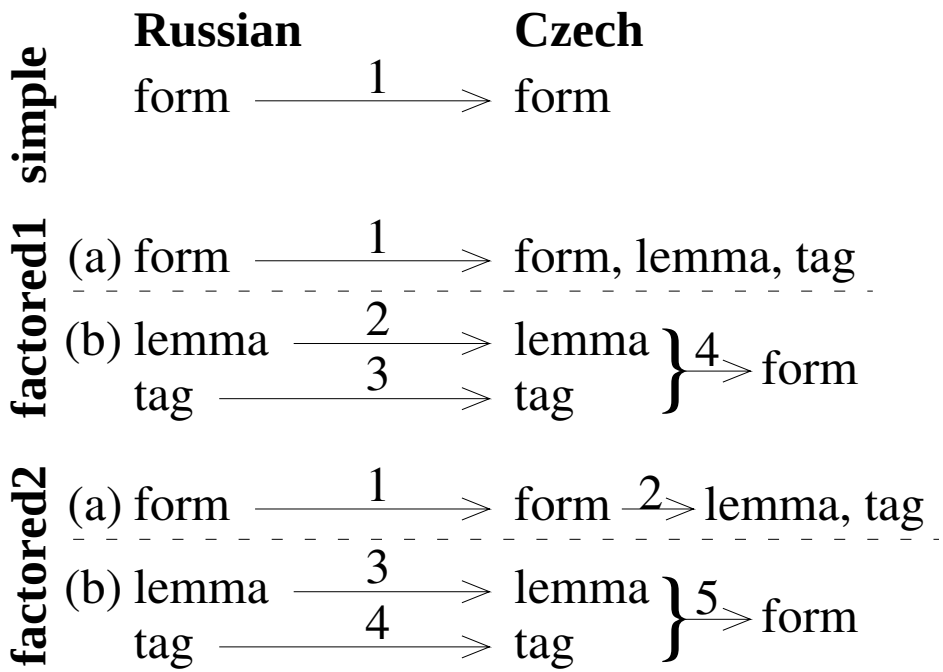
Running Moses

- direct transfer (simple)
- factored – two decoding paths
  1. (T) F.form → E.form, E.lemma, E.tag
  2. (T) F.lemma → E.lemma
     (T) F.tag → E.tag
     (G) E.lemma + E.tag → E.form
     + three separate LMs: for forms, lemmas and forms

Calling train-factored-phrase-model.perl

-lm 0:3:"$(WORK)/lm/cer.lctok.form.cz.blm"
-lm 1:3:"$(WORK)/lm/cer.lctok.lemma.cz.blm"
-lm 2:3:"$(WORK)/lm/cer.lctok.tag.cz.blm"
-translation-factors 0-0,1,2+1-1+2-2
-generation-factors 1,2-0
-decoding-steps t0:t1,t2,g0

explored settings



Evaluation of machine translation

evaluation criterion

- no single criterion
  - preserves meaning
  - outputs grammatical sentences
  - what type of errors occure
  - how much time/money does it take to correct the output, etc.
- we do not know user's needs

our evaluation criterion

- automatic metric Bleu
- manual evaluation
  - error analysis: missing word, extra word, bad word form, ...
  - ranking – order translations of different systems

Evaluation – error analysis

- manual flagging of errors
- judge only of simple model (limited human resources)
- overview of errors

Error Class	en→cs	ru→cs
Disambiguation	9.3 %	8.8 %
Extra word	6.2 %	18.2 %
Word Form	49.0 %	22.0 %
Lexical Variant	5.4 %	5.7 %
Missed Auxilary	0.8 %	1.9 %
Missed Content	6.6 %	20.1 %
Word Order Long	0.8 %	0.6 %
Word Order Short	4.6 %	0.6 %
Punctuation	13.9 %	2.5 %
Unknown	3.5 %	19.5 %
Total	259 (100.0%)	159 (100.0%)

Evaluation – ranking

- which system produced the best translation?

En→Cz	simple	factored1	factored2
Best/Second	2/8	9/6	4/6

Ru→Cz	simple	factored1	factored2
Best/Second	10/12	19/9	—

- ru→cz, factored1 was the best the most times
- factorization helped particularly for translation from Russian

Evaluation – Bleu

- no significant improvement for English → Czech
- useful for Russian to Czech
- achieved Bleu scores in our experiments

	BLEU score on forms		
pair	simple	factored1	factored2
en→cs	14.58±0.96	15.84±1.03	15.39±1.05
ru→cs	11.91±0.91	13.11±0.90	—

	BLEU score on lemmas		
pair	simple	factored1	factored2
en→cs	24.16±1.10	24.77±1.18	24.99±1.16
ru→cs	15.98±0.97	18.06±0.92	—

Typical errors

Russian → Czech

- negation
  (cs ref) bez něhož nebylo možné sestavit
  (ru → cs): bez něhož bylo možné vytvořit
- reflexives
  (ru src) сумел уйти от
  (ru → cs) podařilo odejít od

English → Czech

- word order in possessive constructions
  (en src) mahmoud abbas 's palestinian authority
  (cs ref) palestinskou samosprávou prezidenta mahmúda abbáse
  (en → cs) prezidenta mahmúda abbáse palestinské samosprávy

Typical errors (2)

Both source languages → Czech

- Bad case after a preposition.
  (cs ref) podle indických vyšetřovatelů
  (en src) according to indian investigators
  (en → cs) podle indické řešitelů
  (ru src) согласно индийским экспертам
  (ru → cs) podle indickým experti

Conclusion

- less number of errors in errors flagging advices that translation from Russian is simpler
- it is also supported by manual ranking
- factorization is useful particularly for translation from Russian