The TALP N-gram based Machine Translation System

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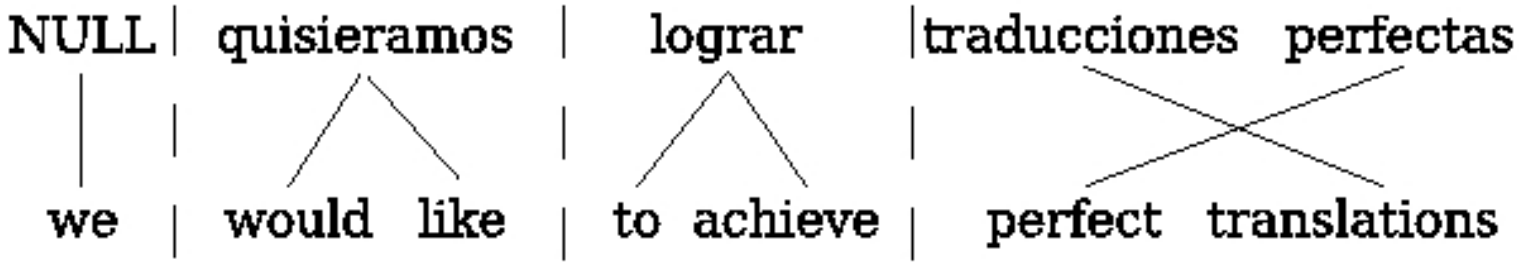
The translation model

- Translation Model:
  N-gram language model of bilingual units (tuples)

$$p(S,T) = \prod_{k=1}^{K} p((\tilde{s},\tilde{t})_k | (\tilde{s},\tilde{t})_{k-N+1}, ..., (\tilde{s},\tilde{t})_{k-1})$$

- Tuples are extracted from word alignment
  - A unique, monotonous segmentation of each sentence pair is produced.
  - No word in a tuple is aligned to words outside of it
  - No smaller tuples can be extracted without violating the previous constraints

Tuple extraction



Tuples:
1.- NULL : we
2.- quisieramos : would like
3.- lograr : to achieve
4.- traducciones perfectas : perfect translations

Phrases:
1.- quisieramos : would like
2.- quisieramos : we would like
3.- lograr : to achieve
4.- traducciones : translations
5.- perfectas : perfect
6.- quisieramos lograr : would like to achieve
7.- quisieramos lograr : we would like to achieve
8.- traducciones perfectas : perfect translations
9.- lograr traducciones perfectas : to achieve perfect translations
10.- quisieramos lograr traducciones perfectas : would like to achieve perfect translations
11.- quisieramos lograr traducciones perfectas : we would like to achieve perfect translations

From the translation model to the translation system

- n-gram-based translation model alone can produce translations, but search is better guided with more models
- $\hat{T} = \arg\max_{T} \sum_m \lambda_m h_m(S, T)$; Features:
  - Target language model (standard n-gram model)
  - Word bonus model: $p_{WP}(T) = exp(\text{number of words in } T)$.

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  - Word bonus model: $p_{WP}(T) = exp(\text{number of words in } T)$.
  - A source-target lexical model, which use IBM1 translation probabilities to compute a lexical weight for each tuple

$$p_{IBM1}((\tilde{s}, \tilde{t})_k) = \frac{1}{(I+1)^J} \prod_{j=1}^{J} \sum_{i=0}^{I} p(t_k^i | s_k^j)$$

  - A target-source lexical model
- Model weights optimisation: implementation of a tool based on two possible algorithms: Downhill Simplex and SPSA

N-gram-based (NB) vs Phrase-based (PB) SMT

- Similar number of translation units
- Lower decoding time for N-gram based MT (unique vs multiple segmentation of sentence pair)
- PB system not very sensitive to histogram pruning parameter. NB system more sensitive. Interpretation:
  - PB partial hypotheses scored uncontextualized.
  - NB approach: bad sequence of tuples composed of a good initial sequence may cause the pruning of the rest of hypotheses

MARIE decoder

- Ngram-based Statistical Machine Translation decoder: MARIE [Crego *et al.*, 2005]
- Also works for Phrase-based SMT (N=1)
- New version (LIMSI): N-coder: unrestricted input word graph. Many applications (augmenting the input graph):
  - various word segmentations of Chinese
  - various tokenization of Arabic
  - synonyms of input words better modelled in translation model
  - etc.

N-gram based MT at the NCLT

- Easy-to-use-for-NCLT-people N-gram based system and scripts will be available
- If the LIMSI allows it, new "N-coder" will be available to NCLT (at least the binary)