Pre- and Postprocessing Techniques for SMT Output Quality Improvement

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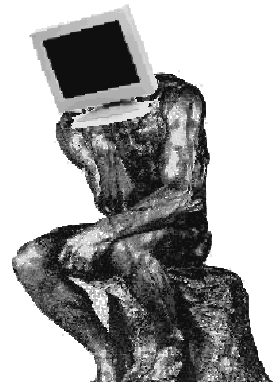
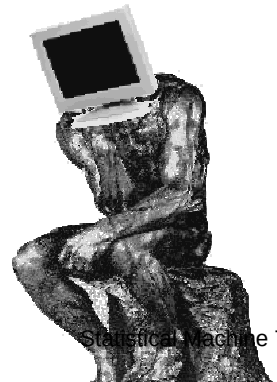
26. september 2006

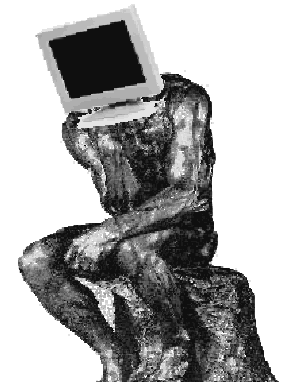


Summary:

- Some words about SMT
- Some existing output improvement techniques
- Suggested new output improvement techniques



Statistical Machine Translation

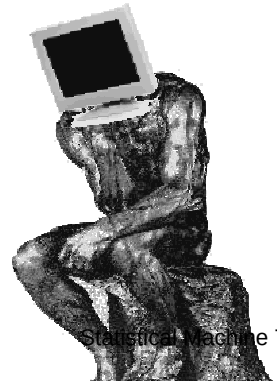


Statistical Machine Translation

Translating from "foreign" into "English":

- e – English sentence
- f – foreign sentence
- $p(e)$ – probability of e being a correct sentence
- $p(e|f)$ – probability of e being the translation of f

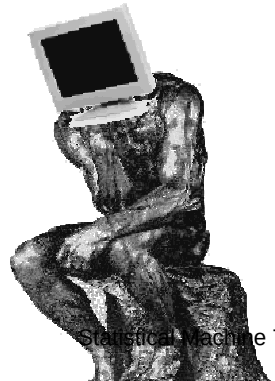
$$\begin{aligned} \hat{e} = \arg\max_e p(e|f) &= \arg\max_e \frac{p(e)p(f|e)}{p(f)} \\ &= \arg\max_e p(e)p(f|e) \end{aligned}$$



Statistical Machine Translation

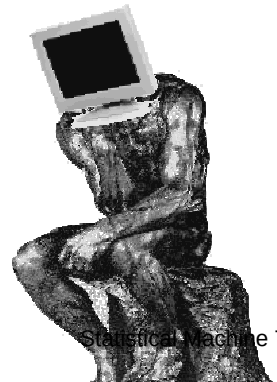
$$\hat{e} = \arg\max_{e} p(e)p(f|e)$$

- $p(e)$ – language model
- $p(f|e)$ – translation model
- arg max – decoder



Decoder Output

$$\text{maison rouge} \quad \rightarrow \quad \begin{matrix}\text{LM} \\ \text{TM}\end{matrix} \quad \rightarrow \quad \begin{matrix} p(\text{house red}) = 0.6 \\ p(\text{red house}) = 0.2 \\ \ldots \end{matrix}$$



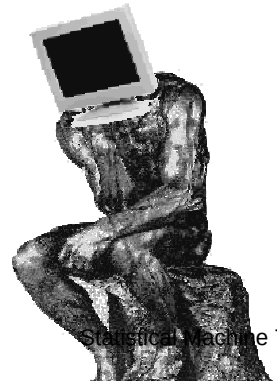
Output Correction

Via postprocessing:

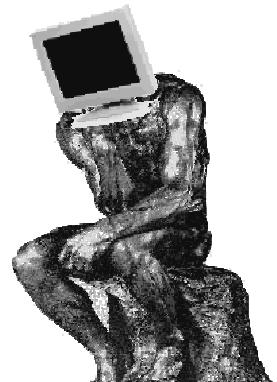
$$\text{maison rouge} \quad \rightarrow \quad \begin{matrix}\text{LM}\\ \text{TM}\end{matrix} \quad \rightarrow \quad \begin{matrix} p(\text{house red}) = 0.6(0.3) \\ p(\text{red house}) = 0.2(0.8) \\ \ldots \end{matrix}$$

Via preprocessing:

$$\text{rouge maison} \quad \rightarrow \quad \begin{matrix}\text{LM}\\ \text{TM}\end{matrix} \quad \rightarrow \quad \begin{matrix} p(\text{red house}) = 0.7 \\ p(\text{house red}) = 0.1 \\ \ldots \end{matrix}$$

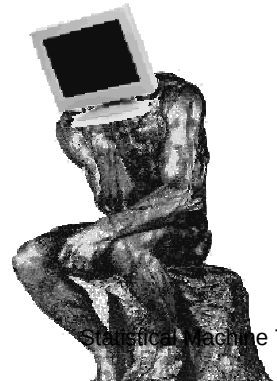


Existing output improvement techniques



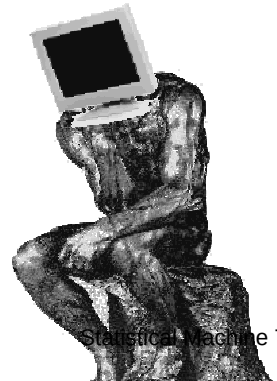
Existing techniques: 1

- Replace inflected word with stem and morphological description
  - useful if translating from highly agglutinative to less agglutinative language (e.g. Estonian/German to English)
  - example:
    poiss – the boy
    poisiga → poiss ga – with the boy
    poisile → poiss le – to the boy

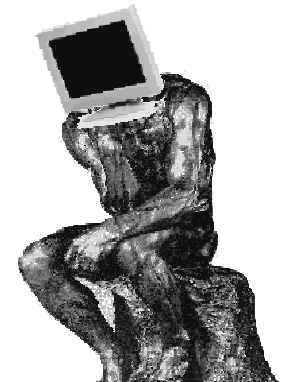


Existing techniques: 2

- Put source language words in the target language order
  - ich mache die Tür zu →
    ich zu mache die Tür →
    i close the door

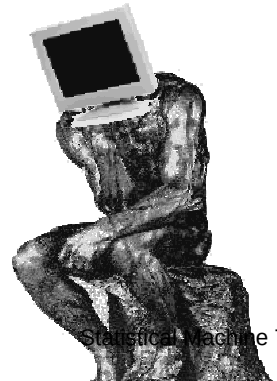


Suggested new output improvement techniques



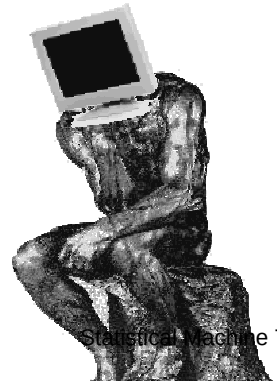
Idea-1

- replace words in monolingual corpus with parts-of-speech (PoS)
- train a LM on that corpus
- use it together with (or instead of) the usual LM
  - more general, assistive in case of sparse data



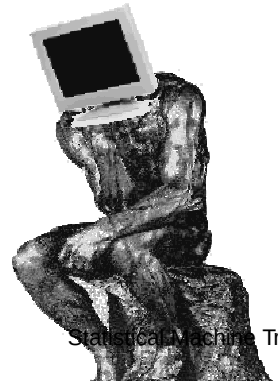
Idea-2

- replace words in bilingual corpus with PoS
- train 2 translators: for words and for PoS
- translate in parallel the sentence and the PoS sequence
- choose the word sequence in the N-best list which matches best the translated PoS sequence
  - translating parts-of-speech should work well because of the limited lexicon



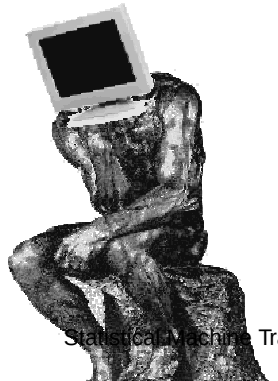
Idea-2.1

- translate separately stemmed words and their morphological descriptions
- use morphological synthesis to obtain the actual translation



Idea-3

- let f be the input and e_i the output sentences from the N-best list;
- use one of ML techniques (NN, TBL, SVM, ...) to tell whether the pair $< f, e_i >$ is correct (e_i is the translation of f)



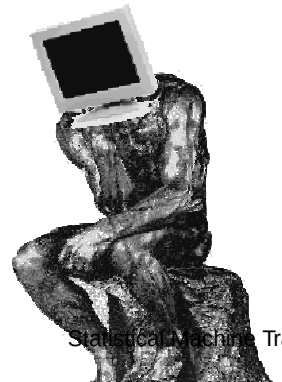
Idea-3

- main problem: training/testing data
  - is it possible to solve

$$F(e_i, e_{orig}) = e_i \text{ “distance” from } e_{orig}$$

(F decides whether e_{i_0} is the closest to e_{orig} for all possible i)

- if possible, each N-best list provides us with 1 positive and $N - 1$ negative pairs



Thank You!