

## Ling 575: Alignment

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github: <https://github.com/johncadigan/WordAlignment.git>

run: compile2.10.sh then run.sh

### Motivation

I explored some multi-threaded and combined alignment approaches to improve the model, but I did not have much success. I did find ways of formulating the calculations which will resemble those I will use on Spark for my project.

### Description

*IBM Model 1*

I used the standard IBM Model 1. To help it converge faster, I set every target word  $e$  and is set to be equally probable from each of the  $n$  words from  $f$  it is found with  $P(e|f) = \frac{1}{n+1}$

With each iteration of the EM algorithm, two maps are used to store the expected probability counts are created:  $count(e|f)$  and  $count(f)$ . Then for each sentence the deltas are calculated for every target word; the delta is the sum of all the translation probabilities which apply to target word

$$delta(e_i) = \sum_{f \in F} P(e_i|f)$$

For each possible combination of  $e$  and  $f$ , the counts are both incremented by the probability divided by delta

$$count(e|f) += \frac{P(e|f)}{delta(e)} \quad count(f) += \frac{P(e|f)}{delta(e)}$$

After all sentences, these counts are normalized to produce newer, more accurate estimations of  $P(e|f)$  and the process continues until all iterations are complete

$$P(e|f) = \frac{count(e|f)}{count(f)}$$

*Alignment and symmetrization*

I then go through every sentence and output the highest probable alignment for each word based only on  $P(e|f)$ . I then unify the output from models trained in each direction to recover more translations and only report translations found by both.

### Results

Iterations	Precision	Recall	AER
5	0.870	0.659	.235
10	0.866	0.671	0.229
20	0.863	0.674	0.229