NLP Short Homework Assignment 3
Due Midnight of the 27th Class

Let's assume an Expectation Maximization algorithm for training a one to one word alignment model like the one discussed in class. The translation probabilities generated from an estimation step is given below. Using the probabilities below, calculate the probabilities of **all** 6 possible word alignments between

the Spanish phrase: **un pollito amarillo**
and the English phrase: **a yellow chick**.

Please round the answer to three significant figures (1.45×10^{-4} or .000145). These calculations are part of the next expectation step. In combination, with the alignments of additional sentence pairs, they will be used to generate the next set of translation probabilities. **Note that we are ignoring one factor in the Birch and Koehn (slide 11) account discussed in class. For purposes of this question $\frac{\epsilon}{(l_f+1)^{l_e}} = 1$.**

Translation Probabilities					
	Source Words (Spanish)				
Target Words (English)	**el**	**un**	**amarillo**	*pato*	**pollito**
the	.88	0	.04	.02	.06
a	0	.82	.09	.09	0
yellow	.05	.04	.78	.06	.07
chick	.14	0	.10	0	.76
duck	.02	.03	.05	.9	0

Answers: List each possible alignment, along with the total probability, e.g., one possible alignment is: **un/yellow pollito/chick amarillo/a** and the probability is based on the table above.

1. un/a   pollito/yellow   amarillo/chick
   0.82 × 0.07 × 0.10 = 0.00574

2. un/a   pollito/chick   amarillo/yellow
   0.82 × 0.76 × 0.78 = 0.486096 ≈ 0.486

3. un/yellow pollito/a   amarillo/chick
   0.04 × 0 × 0.1 = 0

4. un/yellow pollito/chick   amarillo/a
   0.04 × 0.76 × 0.09 = 0.002736 ≈ 0.00274

5. un/chick pollito/yellow   amarillo/a
   0 × 0.07 × 0.09 = 0

6. un/chick pollito/a   amarillo/yellow
   0 × 0 × 0.78 = 0