These are sentence pairs in the (Centauri, Arcturan) made-up languages.
Learn the translation dictionary and word alignments.
The translation dictionary is mostly nonambiguous,
EM for Model 1
Here there are 4 words in both the foreign and English vocabularies. There are 3 sentences in
the training data. Assume no NULLs. Initialize the translation parameters to be uniform:

<table>
<thead>
<tr>
<th></th>
<th>das</th>
<th>ein</th>
<th>Buch</th>
<th>Haus</th>
</tr>
</thead>
<tbody>
<tr>
<td>the</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
</tr>
<tr>
<td>a</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
</tr>
<tr>
<td>book</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
</tr>
<tr>
<td>house</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
</tr>
</tbody>
</table>

\[
t(\text{fle}) \\
\text{Translation probs} \\
\text{Every row is one } t(\text{fle}) \text{ prob dist.}
\]

1a. E-step: Given \( t(\text{fle}) \), calculate posterior alignments over the training data.
Each English word came from one German word in the sentence. Which?

\[
p(\text{Buch from "book"}) = \frac{t(\text{Buch} \mid \text{book})}{t(\text{Buch} \mid \text{book}) + t(\text{Buch} \mid \text{a})}
\]

1b. M-step: Given these posterior alignments,
(1) calculate fractional translation counts ........ (2) normalize into a new translation probability table.

2a. E-step

2a. M-step

\[
t(\text{fle}): \text{Translation PROBS} \\
t(\text{fle}): \text{Translation PROBS}
\]