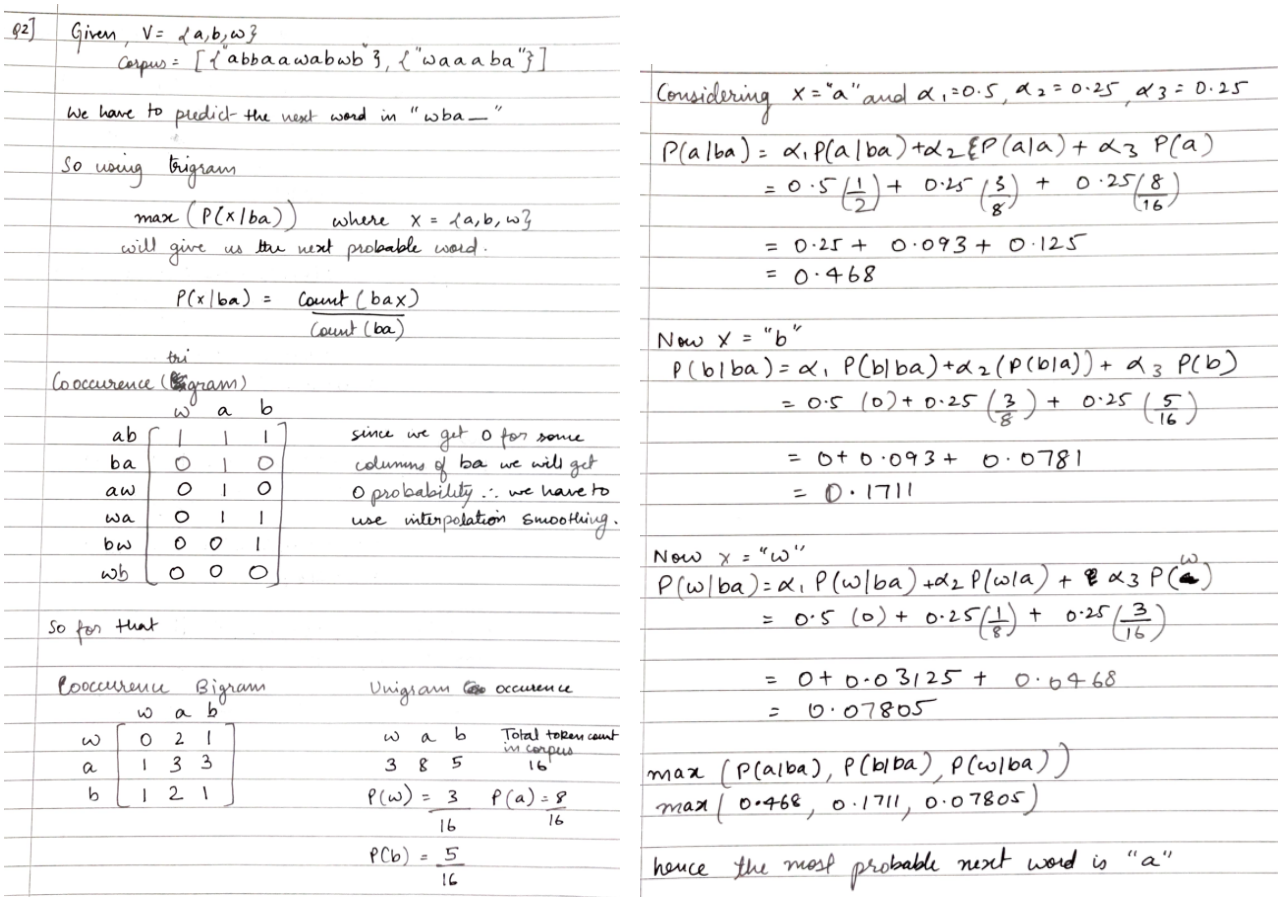
CSE556: NLPQuiz - 2 - Solutions

Answers are in red color.

1. "Smoothing always incurs some information loss to the original counts". Justify or refute. **[3]**

   Smoothing is a mechanism to prevent assigning zero probabilities to unknown or out-of-vocabulary words. We borrow some probability mass from observed/seen words (bigrams/trigrams, etc.) and distribute it among OOVs. Since probability value is directly proportional to the word count, reducing the probability will reduce the counts as well.

2. Let V = {a, b, w}, Corpus: [{"a b b a a w a b w b"}, {"w a a a b a"}]. Utilizing the trigram LM, find the next predicted word in the sequence "w b a ____". Use **Interpolation** as the smoothing technique, in case you're getting zero co-occurrence counts. Take appropriate alpha values. **Show computation**. **[15]**



Q2] Given, V = {a, b, w}

Corpus = [{"abbaawabwb"}, {"waaaba"}]

We have to predict the next word in "wba__"

So using trigram

max (P(x|ba)) where x = {a, b, w}

will give us the next probable word.

$$P(x|ba) = \frac{\text{Count}(bax)}{\text{Count}(ba)}$$

tri

Cooccurrence (Bigram)

	w	a	b
ab	1	1	1
ba	0	1	0
aw	0	1	0
wa	0	1	1
bw	0	0	1
wb	0	0	0

since we get 0 for some columns of ba we will get 0 probability ∴ we have to use interpolation smoothing.

So for that

Cooccurrence Bigram

	w	a	b
w	0	2	1
a	1	3	3
b	1	2	1

Unigram occurrence

w	a	b	Total token count in corpus
3	8	5	16

$P(w) = \frac{3}{16}$ $P(a) = \frac{8}{16}$

$P(b) = \frac{5}{16}$

Considering x = "a" and $\alpha_1 = 0.5$, $\alpha_2 = 0.25$, $\alpha_3 = 0.25$

$P(a|ba) = \alpha_1 P(a|ba) + \alpha_2 P(a|a) + \alpha_3 P(a)$

$= 0.5\left(\frac{1}{2}\right) + 0.25\left(\frac{3}{8}\right) + 0.25\left(\frac{8}{16}\right)$

$= 0.25 + 0.093 + 0.125$

$= 0.468$

Now x = "b"

$P(b|ba) = \alpha_1 P(b|ba) + \alpha_2 (P(b|a)) + \alpha_3 P(b)$

$= 0.5\ (0) + 0.25\left(\frac{3}{8}\right) + 0.25\left(\frac{5}{16}\right)$

$= 0 + 0.093 + 0.0781$

$= 0.1711$

Now x = "w"

$P(w|ba) = \alpha_1 P(w|ba) + \alpha_2 P(w|a) + \alpha_3 P(w)$

$= 0.5\ (0) + 0.25\left(\frac{1}{8}\right) + 0.25\left(\frac{3}{16}\right)$

$= 0 + 0.03125 + 0.0468$

$= 0.07805$

max (P(a|ba), P(b|ba), P(w|ba))

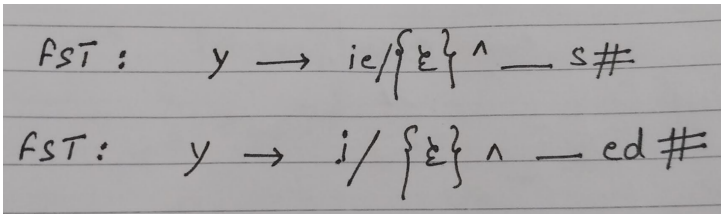
max (0.468, 0.1711, 0.07805)

hence the most probable next word is "a"

3. Write shorthand orthographic rules (similar to the equation below) for Y replacement -- "*-y* changes to *-ie* before *-s*, *-i* before *-ed*". **[4]**

$$FST_i: \quad \varepsilon \rightarrow e \,/\, \left\{ \begin{matrix} x \\ s \\ z \end{matrix} \right\} \hat{}\_\_\ s\#$$

[No partial marking.]



4. Write the **lexical** and **intermediate** forms for the surface forms **Boys**, **Cities**, and **Fish**. Use conventional notations. **[8]**

Surface ⇒ Intermediate (4 marks) ⇒ Lexical (4 marks)

Boys ⇒ Boy ^ s # ⇒ Boy +N +pl
Cities ⇒ City ^ s # ⇒ City +N +pl
Fish ⇒ Fish # ⇒ Fish +N +sg
Fish ⇒ Fish # ⇒ Fish +N +pl