# SMOOTHING USING BIAGRAM

**Problems with simple MLE estimates :zero**

**Zero probability n-gram problem.**

**We can not compute perplexity and chain rule for the sentences.**

**so we a use the Laplace smoothing(Add-one estimation)**

**Just add one to all the count!**

**$P(w_i| w_{i-1})=count(w_{i-1}w_i) + 1/count(w_{i-1})+v$**

**<S> JOHN READ MOBY DICK </S>**

**<S> MARY READ A DIFFERENT BOOK </S>**

**<S> SHE READ A BOOK BY CHER </S>**

**V=11 (total number of different word present in corpus)**

**Using smopthing the probability of bigram is…**

**$P(w_i| w_{i-1})=count(w_{i-1}w_i) + 1/count(w_{i-1})+v$**

**P( JOHN | <S>) =count(<S>, JOHN) +1/count(<S>)+V**

**=(1+1)/(3+11)=2/14**

**P(READ | JOHN) =count(JOHN, READ) +1/count(JOHN)+V**

**=(1 +1)/(1+11)=2/12**

P(A | READ) =(2 +1)/(3+11)=3/14

P(BOOK | A) =(1+1)/(2+11)=2/13

P(</S> | BOOK) =(1+1)/(2+11)=2/13

P( CHER | <S>) =(0 +1)/(3+11)=1/14

P(READ | CHER)=(0+1)/(1+11)=1/12

P(JOHN READ A BOOK) = P( JOHN | <S>) * P(READ | JOHN) *

P(A | READ) * P(BOOK | A) * P(</S> | BOOK)

=2/14 * 2/12 * 3/14 * 2/13 * 2/13

=0.0001

P(CHER READ A BOOK) = P( CHER | <S>) * P(READ | CHER) *

P(A | READ) * P(BOOK | A) * P(</S> | BOOK)

= 1/14 * 1/12 * 3/14 * 2/13 * 2/13

=0.00003

# SMOOTHING USING TRIAGRAM

<S> JOHN READ MOBY DICK </S>

<S> MARY READ A DIFFERENT BOOK </S>

<S> SHE READ A BOOK BY CHER </S>

P( JOHN | <S>) =count(<S>, JOHN) +1/count(<S>)+V

=(1+1)/(3+11)=2/14

P(READ |JOHN,<S>)=count(<S>,JOHN,READ)+1/count(<S>,JOHN)+V

=(1+1)/(1+11)=2/12

P(A| JOHN,READ) =count(JOHN,READ,A)+1/count(JOHN,READ)+V

=(0 + 1)/(1+11)=1/12

P(BOOK| READ ,A) =count(READ,A,BOOK)+1/count(READ,A)+V

=(1+1)/(2+11)=2/13

P(</S>|A,BOOK) =count(A,BOOK,</S>)+1/count(A,BOOK)+V

=(0+1)/(1+11)=1/12

P( CHER | <S>) =count(<S>, CHER) +1/count(<S>)+V

=(0+1)/(3+11)=1/14

P(READ |CHER,<S>)=count(<S>,CHER,READ)+1/count(<S>,CHER)+V

=(0+1)/(0+11)=1/11

P(A| JOHN,READ) =count(CHER,READ,A)+1/count(CHER,READ)+V

=(0 + 1)/(0+11)=1/11

P(JOHN READ A BOOK)= P( JOHN | <S>) * P(READ |JOHN,<S>) *

P(A| JOHN,READ) * P(BOOK| READ ,A) * P(</S>|A,BOOK)

=2/14 * 2/12 * 1/12 * 2/13 * 1/12

=0.00002543752

$$P(\text{CHER READA BOOK})= P(\text{CHER} \mid \langle S\rangle) * P(\text{READ} \mid \text{CHER},\langle S\rangle) *$$

$$P(\text{A} \mid \text{CHER},\text{READ}) * P(\text{BOOK} \mid \text{READ},\text{A}) * P(\langle /S\rangle \mid \text{A},\text{BOOK})$$

$$=1/14 * 1/11 * 1/11 * 2/13 * 1/12$$

$$=0.00000756818$$