

Initialization: Set $\pi(0, (START,*), (START,*), (START,*)) = 1$

Algorithm:

We will define $S_k = V * K_k$

1. For $k = 1 \dots n$.
 - 1.1. For $w \in S_{k-2} u \in S_{k-1}, v \in S_k$
 - 1.1.1. $\pi(k, u, v, w) = \max_{j \in S_{k-3}} [\pi(k-1, j, u, v) * q(v|j, u, w) * e(v)]$
 - 1.1.2. $bp(k, u, v, w) = \max_{j \in S_{k-3}} [\pi(k-1, j, u, v) * q(v|j, u, w) * e(v)]$
2. Set $Y_{n-2}, Y_{n-1}, Y_n = \operatorname{argmax}_{(w,u,v)} (\pi(k, w, u, v) * q((STOP,*)|w, u, v))$
3. For $k = (n-3), \dots, 1$:
 - 3.1. $Y_k = bp(k, Y_{k+1}, Y_{k+2}, Y_{k+3})$

ret

b.2) known words error = 0.08289951871132502 , unknown words error = 0.7960812772133526

total error = 0.16792110044121464

c.3) total error = 0.8705770395362921

d.2) total error = 0.7818150359027598

e.2) total error = 0.6773942382559045

e.3) total error = 0.510857340600398