Natural Language Processing (COS4861)

Adriaan Louw (53031377)

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1 Question 1

1.1

2 Question 2

For $V_2(1)$:

$$\begin{aligned} V_1(1)P(PPSS \mid PPSS) &= (0.025)(0.00014) \\ &= 0.0000035 \end{aligned} \tag{1}$$

$$\begin{aligned} V_1(2)P(PPSS \mid VB) &= (0)(0.007) \\ &= 0 \end{aligned} \tag{2}$$

$$\begin{aligned} V_1(3)P(PPSS \mid TO) &= (0)(0) \\ &= 0 \end{aligned} \tag{3}$$

$$\begin{aligned} V_1(4)P(PPSS \mid NN) &= (0)(0.0045) \\ &= 0 \end{aligned} \tag{4}$$

$$\begin{aligned} V_2(1) &= max(0.0000035, 0, 0, 0)P(want \mid PPSS) \\ &= (0.0000035)(0) \\ &= 0 \end{aligned} \tag{5}$$

For $V_2(3)$:

$$\begin{aligned} V_1(1)P(TO \mid PPSS) &= (0.025)(0.00079) \\ &= 0.00001975 \end{aligned} \tag{6}$$

$$\begin{aligned} V_1(2)P(TO \mid VB) &= (0)(0.035) \\ &= 0 \end{aligned} \tag{7}$$

$$V_1(3)P(TO \mid TO) = (0)(0) = 0 \tag{8}$$

$$V_1(4)P(TO \mid NN) = (0)(0.016) = 0 \tag{9}$$

$$\begin{aligned} V_2(3) &= max(0.00001975, 0, 0, 0)P(want \mid TO) \\ &= (0.00001975)(0) \\ &= 0 \end{aligned} \tag{10}$$

For $V_2(4)$:

$$V_1(1)P(NN \mid PPSS) = (0.025)(0.0012) = 0.00003 \tag{11}$$

$$V_1(2)P(NN \mid VB) = (0)(0.047) = 0 \tag{12}$$

$$V_1(3)P(NN \mid TO) = (0)(0.00047) = 0 \tag{13}$$

$$V_1(4)P(NN \mid NN) = (0)(0.087) = 0 \tag{14}$$

$$\begin{aligned} V_2(4) &= max(0.00003, 0, 0, 0)P(want \mid NN) \\ &= (0.00003)(0.000054) \\ &= 0.00000000162 \end{aligned} \tag{15}$$

For $V_3(1)$:

$$V_2(1)P(PPSS \mid PPSS) = (0)(0.00014) = 0 \tag{16}$$

$$V_2(2)P(PPSS \mid VB) = (0.000051)(0.007) = 0.000000357 \tag{17}$$

$$V_2(3)P(PPSS \mid TO) = (0)(0) = 0 \tag{18}$$

$$V_2(4)P(PPSS \mid NN) = (0.00000000162)(0.0045) \\ = 0 \tag{19}$$

$$V_3(1) = max(0, 0.000000357, 0, 7.29 * 10^{-12})P(to \mid PPSS) \\ = (0.000000357)(0) \\ = 0 \tag{20}$$

For $V_3(2)$:

$$V_2(1)P(VB \mid PPSS) = (0)(0.23) \\ = 0 \tag{21}$$

$$V_2(2)P(VB \mid VB) = (0.000051)(0.0038) \\ = 1.938 * 10^{-7} \tag{22}$$

$$V_2(3)P(VB \mid TO) = (0)(0.83) \\ = 0 \tag{23}$$

$$V_2(4)P(VB \mid NN) = (1.62 * 10^{-9})(0.0045) \\ = 6.48 * 10^{-12} \tag{24}$$

$$V_3(2) = max(0, 1.938 * 10^{-7}, 0, 6.48 * 10^{-12})P(to \mid VB) \\ = (1.938 * 10^{-7})(0) \\ = 0 \tag{25}$$

For $V_3(3)$:

$$V_2(1)P(TO \mid PPSS) = (0)(0.00079) \\ = 0 \tag{26}$$

$$V_2(2)P(TO \mid VB) = (0.000051)(0.0035) \\ = 0.000001785 \tag{27}$$

$$V_2(3)P(TO \mid TO) = (0)(0) \\ = 0 \tag{28}$$

$$V_2(4)P(TO \mid NN) = (1.62 * 10^{-9})(0.016) \\ = 2.592 * 10^{-11} \tag{29}$$

$$\begin{aligned} V_3(3) &= max(0, 0.000001785, 0, 2.592 * 10^{-11}) P(to \mid TO) \\ &= (0.000001785)(0.99) \\ &= 0.00000176715 \end{aligned} \tag{30}$$

For $V_3(4)$:

$$\begin{aligned} V_2(1)P(TO \mid PPSS) &= (0)(0.0012) \\ &= 0 \end{aligned} \tag{31}$$

$$\begin{aligned} V_2(2)P(TO \mid VB) &= (0.000051)(0.047) \\ &= 0.000002397 \end{aligned} \tag{32}$$

$$\begin{aligned} V_2(3)P(TO \mid TO) &= (0)(0.00047) \\ &= 0 \end{aligned} \tag{33}$$

$$\begin{aligned} V_2(4)P(TO \mid NN) &= (1.62 * 10^{-9})(0.087) \\ &= 1.4094 * 10^{-10} \end{aligned} \tag{34}$$

$$\begin{aligned} V_3(4) &= max(0, 0.000002397, 0, 1.4094 * 10^{-10}) P(to \mid NN) \\ &= (0.000002397)(0) \\ &= 0 \end{aligned} \tag{35}$$

For $V_4(1)$:

$$\begin{aligned} V_3(1)P(PPSS \mid PPSS) &= (0)(0.00014) \\ &= 0 \end{aligned} \tag{36}$$

$$\begin{aligned} V_3(2)P(PPSS \mid VB) &= (0)(0.007) \\ &= 0 \end{aligned} \tag{37}$$

$$\begin{aligned} V_3(3)P(PPSS \mid TO) &= (0.00000176715)(0) \\ &= 0 \end{aligned} \tag{38}$$

$$\begin{aligned} V_3(4)P(PPSS \mid NN) &= (0.00000000162)(0.0047) \\ &= 0 \end{aligned} \tag{39}$$

$$\begin{aligned} V_4(1) &= max(0, 0, 0, 0) P(race \mid PPSS) \\ &= (0)(0) \\ &= 0 \end{aligned} \tag{40}$$

For $V_4(2)$:

$$\begin{aligned} V_3(1)P(VB \mid PPSS) &= (0)(0.023) \\ &= 0 \end{aligned} \tag{41}$$

$$\begin{aligned} V_3(2)P(VB \mid VB) &= (0)(0.0038) \\ &= 0 \end{aligned} \tag{42}$$

$$\begin{aligned} V_3(3)P(VB \mid TO) &= (0.00000176715)(0.83) \\ &= 0.0000014667345 \end{aligned} \tag{43}$$

$$\begin{aligned} V_3(4)P(VB \mid NN) &= (0)(0.0040) \\ &= 0 \end{aligned} \tag{44}$$

$$\begin{aligned} V_4(2) &= max(0, 0, 0.0000014667345, 0)P(race \mid VB) \\ &= (0.0000014667345)(0.00012) \\ &= 1.7600814 * 10^{-10} \end{aligned} \tag{45}$$

For $V_4(3)$:

$$\begin{aligned} V_3(1)P(TO \mid PPSS) &= (0)(0.00079) \\ &= 0 \end{aligned} \tag{46}$$

$$\begin{aligned} V_3(2)P(TO \mid VB) &= (0)(0.035) \\ &= 0 \end{aligned} \tag{47}$$

$$\begin{aligned} V_3(3)P(TO \mid TO) &= (0.00000176715)(0) \\ &= 0 \end{aligned} \tag{48}$$

$$\begin{aligned} V_3(4)P(TO \mid NN) &= (0)(0.016) \\ &= 0 \end{aligned} \tag{49}$$

$$\begin{aligned} V_4(3) &= max(0, 0, 0, 0)P(race \mid TO) \\ &= (0)(0) \\ &= 0 \end{aligned} \tag{50}$$

For $V_4(4)$:

$$\begin{aligned} V_3(1)P(NN \mid PPSS) &= (0)(0.0012) \\ &= 0 \end{aligned} \tag{51}$$

$$V_3(2)P(NN \mid VB) = (0)(0.047) \\ = 0 \tag{52}$$

$$V_3(3)P(NN \mid TO) = (0.00000176715)(0.00047) \\ = 8.305605 * 10^{-10} \tag{53}$$

$$V_3(4)P(NN \mid NN) = (0)(0.087) \\ = 0 \tag{54}$$

$$\begin{aligned} V_4(4) &= max(0, 0, 8.305605 * 10^{-10}, 0)P(race \mid NN) \\ &= (8.305605 * 10^{-10})(0.00057) \\ &= 4.73419 * 10^{-13} \end{aligned} \tag{55}$$

The path can be seen in Figure 1. In each step going to the node with the highest probability. Thus the pat is PPSS VB TO VB

3 Question 3

3.1

4 Question 4

4.1

5 Question 5

5.1

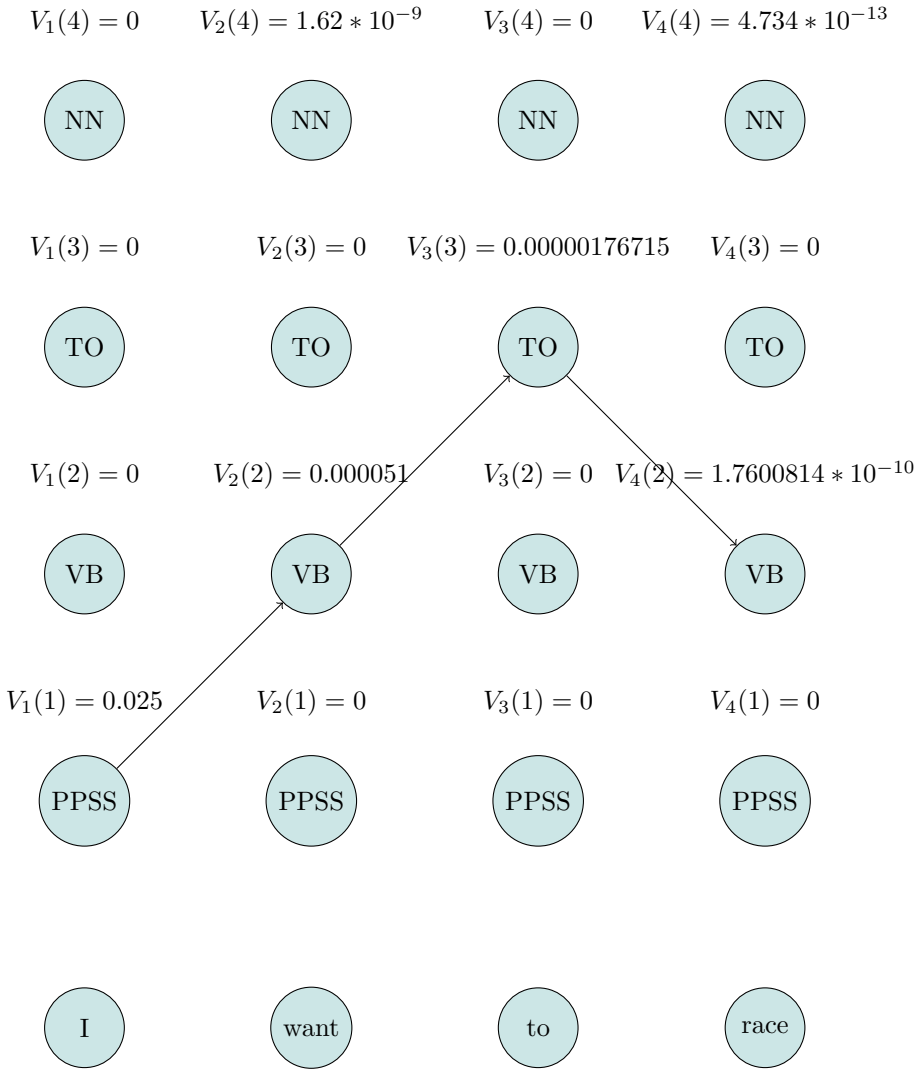

Figure 1: Showing path for question 2