Cpts540 HW11

Lu Xiao

11624097

1. a

Given the following policy, compute the utilities of each non-terminal state, using the equation on slide 58 of the lecture notes, where γ= 0.9. Show your work.

Since turn left and turn right won't change the position, the proof as followed:

$U[2,1] = -1000,$

$U[2,2] = 1000$

$U([1,2], Right) + r\sum_{s'} P(s'|s, GoForward)U(s'),$

=-1+0.9*1000=899

$U([1,2], up) + r\sum_{s'} P(s'|s, TurnRight)U[1,2], Right,$

$=-1+0.9(*(899*0.8) + 0.2*(899)*U[1,2], Right) = 788.15$

$U([1,2], left) + r\sum_{s'} P(s'|s, TurnRight)U(s'),$

$=-1+0.9*(808*0.8) + 0.2*(808) = 726.29$

$U([1,2], down) + r\sum_{s'} P(s'|s, Turnleft)U(s'),$

$=-1+0.9*(808*0.8) + 0.2*(808) = 726.29$

$U([1,1], UP) + r\sum_{s'} P(s'|s, Goforward)U(s'),$

$=-1+0.9*(808*0.8) + 0.2*(808) = 726.29$

$U([1,1], Right) + r\sum_{s'} P(s'|s, TurnLeft)U(s'),$

$=-1+0.9*(808*0.8) + 0.2*(808) = 726.29$

$U([1,1], Left) + r\sum_{s'} P(s'|s, TurnRight)U(s'),$

$=-1+0.9*\left(580.83*0.8 + 0.2*(580.83)\right) = 521.75$

$U([1,1], Down) + r\sum_{s'} P(s'|s, Right)U(s'),$

$=-1+0.9*(580.83*0.8+0.2*(580.83))=521.75$

b. Using temporal difference Q-learning (equation on slide 64 of lecture notes), compute the Q values for Q([1,1,Right],TurnLeft), Q([1,1,Up],GoForward), Q([1,2,Up],TurnRight), Q([1,2,Right],GoForward), after each of five executions of the action sequence: TurnLeft, GoForward, TurnRight, GoForward (starting from [1,1,Right] for each sequence). You may assume $\alpha = 1$, $\gamma = 0.9$, and all Q values for non-terminal states are initially zero. Show your work.

According to the rule:

$Q(s,a) \leftarrow Q(s,a) + \alpha(R(s) + \gamma \max'_a(s',a') - Q(s,a))$

$Q([1,2,Right],GoForward) = 0 + (-1) + 0.9(1000 - 0) = 899$

$Q([1,2,Up],TurnRight) = 0 + (-1) + 0.9(899 - 0)=809.1$

$Q([1,1,Up],Goforward) = 0 + (-1) + 0.9(808.1 - 0) = 726.2$

$Q([1,1,Right],Turnleft) = 0 + (-1) + 0.9(726.2 - 0) = 652.6$

2. Given the following bigram model, compute the probability of the sentence "the agent ate the wumpus". Show your work.

$P(agent|the) * P(\text{ate}|\text{agent}) * P(the|ate) * P(wumpus|the)$

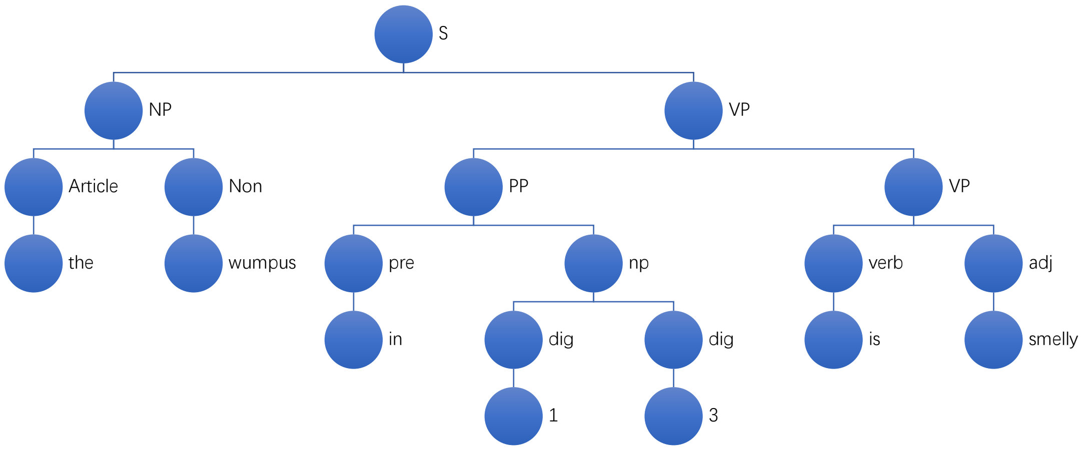
$= \left(\frac{P(the\ agent)}{P(the)}\right) * \left(\frac{P(agent\ ate)}{P(agent)}\right) * \left(\frac{P(ate\ the)}{P(ate)}\right) * \left(\frac{P(the\ wumpus)}{P(the)}\right)$

$= \left(\frac{\frac{5000}{17100}}{\frac{6000}{17100}}\right) * \left(\frac{\frac{100}{17100}}{\frac{600}{17100}}\right) * \left(\frac{\frac{10000}{17100}}{\frac{10000}{17100}}\right) * \left(\frac{\frac{1000}{17100}}{\frac{6000}{17100}}\right)$

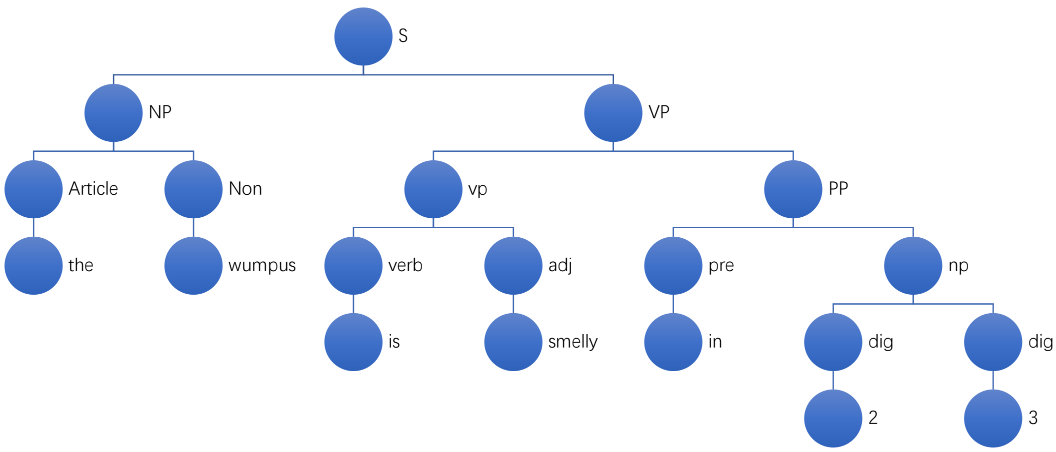
$= 0.02365$

3. Given the lexicon on slide 23 of the lecture notes and the grammar on slide 24 of the lecture notes, show all possible parse trees of each of the following sentences. If there is no parse, then just state "No parse".

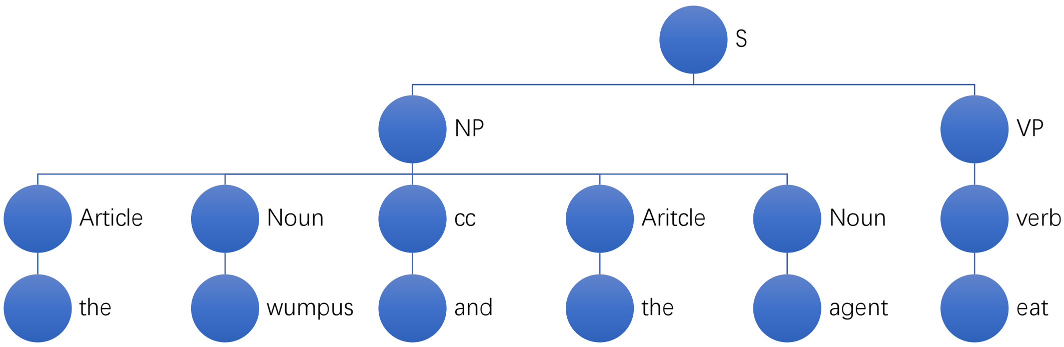
a. "the wumpus in 1 3 is smelly"



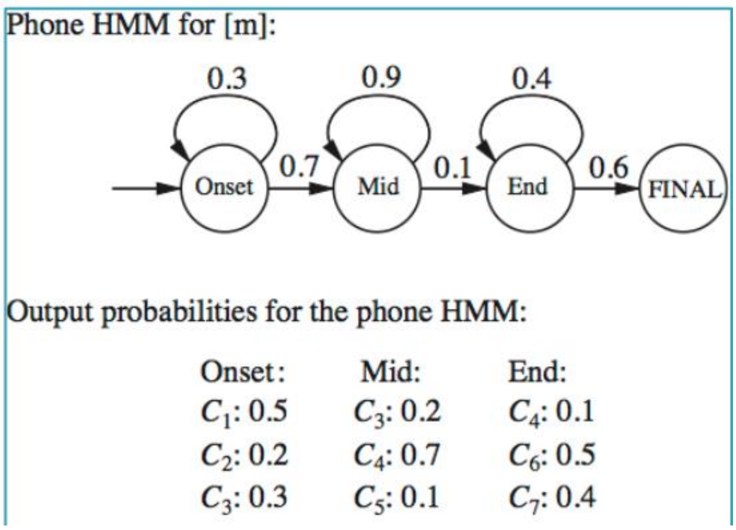
b.“the wumpus is smelly in 2 3”



c. “the wumpus and the agent eat”



4. Given the HMM for the [m] phoneme on slide 40 of the lecture notes, compute the probability of each possible path through the HMM for the sequence of frame features C1,C3,C4,C6. Show your work.



{C1,C3,C4,C6}

Sequence 1: Onset, Onset, Mid, End

=0.5*(0.3*0.3)*(0.7*0.7)*(0.1*0.5)*0.6

= 0.0006615

Sequence 2: Onset, Onset, End, End

=0.5*(0.3*0.3)*(0.7*0.1*0.1)*(0.4*0.5)*0.6

= 0.0000378

Sequence 3: Onset, Mid, Mid, End

=0.5*(0.7*0.2)*(0.9*0.7)*(0.1*0.5)*0.6

= 0.001323

Sequence 4: Onset, Mid, End, End

=0.5*(0.7*0.2)*(0.1*0.1)*(0.4*0.5)*0.6

= 0.000084

5.CptS 540 Students Only. The Stanford Parser is available at nlp.stanford.edu:8080/parser/. For each of the sentences in problem 3, show the parse tree obtained by the Stanford Parser. You may just copy-and-paste the Parse result into your homework submission; no need to draw the parse tree. But make sure the indentation is preserved.

a. the wumpus in 1 3 is smelly

```
(ROOT
  (S
    (NP
      (NP (DT the) (NNS wumpus))
      (PP (IN in)
        (NP
          (QP (CD 1) (CD 3)))))
    (VP (VBZ is)
      (ADJP (JJ smelly)))))
```

b. the wumpus is smelly in 2 3

```
(ROOT
  (S
    (NP (DT the) (NNS wumpus))
    (VP (VBZ is)
      (ADJP (JJ smelly))
      (PP (IN in)
        (NP
          (QP (CD 2) (CD 3)))))))
```

c. the wumpus and the agent eat

```
(ROOT
  (S
```

```
(NP
  (NP (DT the) (NNS wumpus))
  (CC and)
  (NP (DT the) (NN agent)))
(VP (VBP eat))))
```