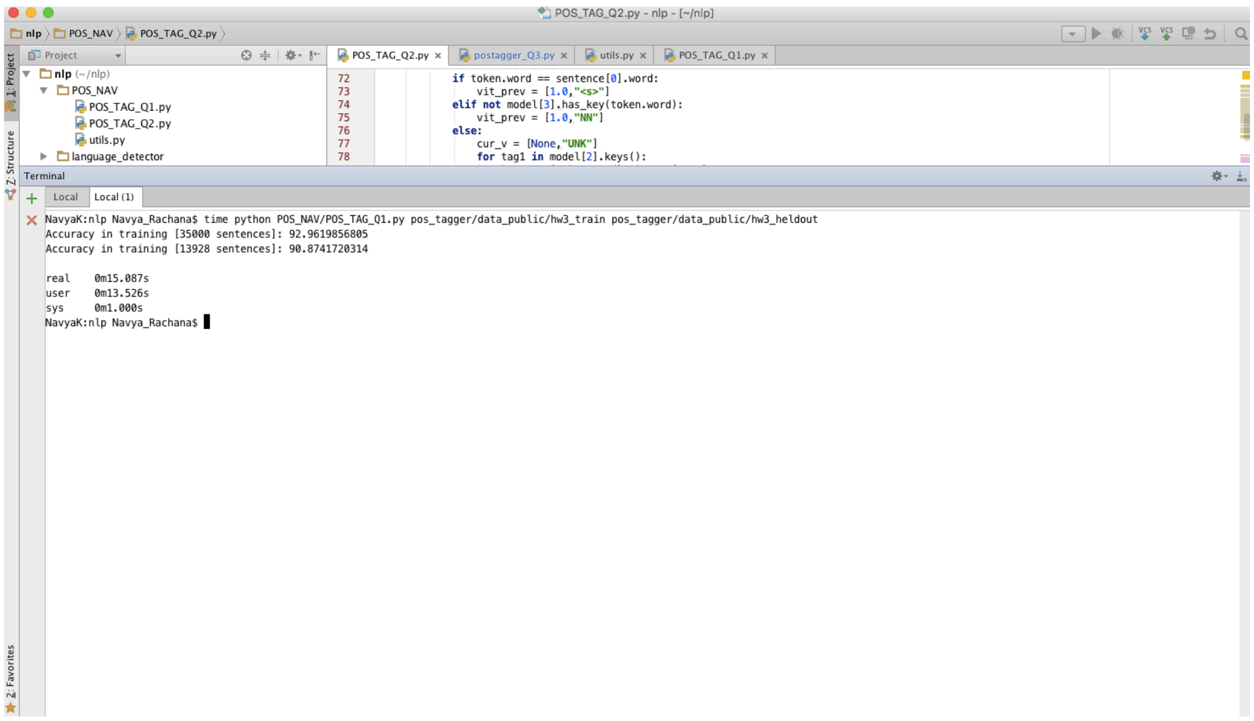
Question 2: Most Likely tag for POSTAGGER:

implementation:

- Initially the program counts all the tags, then the program finds the most likely tag for each word in the training set
- It then assigns the most likely tag to all the words in the testing set and "NN" for unseen words and then calculates the accuracy

Results: (LOWERCASING)



```python
            if token.word == sentence[0].word:
                vit_prev = [1.0,"<s>"]
            elif not model[3].has_key(token.word):
                vit_prev = [1.0,"NN"]
            else:
                cur_v = [None,"UNK"]
                for tag1 in model[2].keys():
```

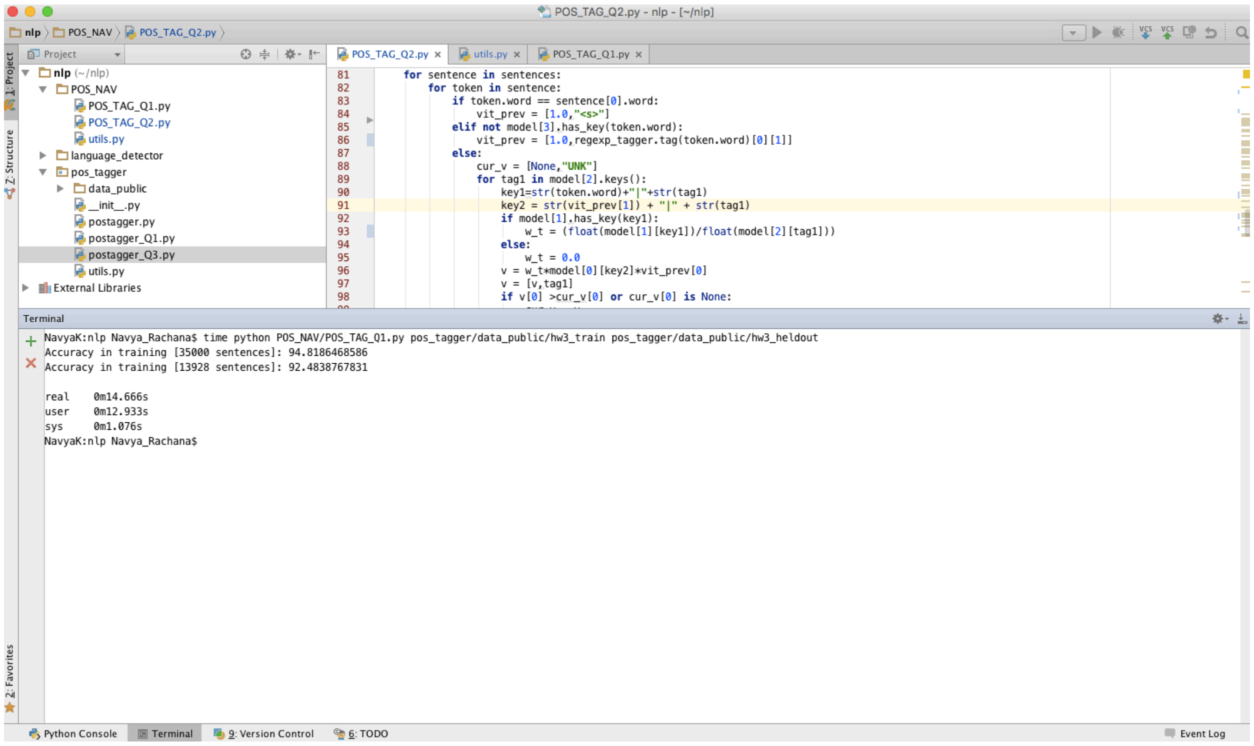
```
NavyaK:nlp Navya_Rachana$ time python POS_NAV/POS_TAG_Q1.py pos_tagger/data_public/hw3_train pos_tagger/data_public/hw3_heldout
Accuracy in training [35000 sentences]: 92.9619856805
Accuracy in training [13928 sentences]: 90.8741720314

real    0m15.087s
user    0m13.526s
sys     0m1.000s
NavyaK:nlp Navya_Rachana$
```

Accuracy in training [35000 sentences]: 92.9619856805
Accuracy in training [13928 sentences]: 90.8741720314

real 0m15.087s
user 0m13.526s
sys 0m1.000s

<u>Results: (NO LOWERCASING)</u>



```python
    for sentence in sentences:
        for token in sentence:
            if token.word == sentence[0].word:
                vit_prev = [1.0,"<s>"]
            elif not model[3].has_key(token.word):
                vit_prev = [1.0,regexp_tagger.tag(token.word)[0][1]]
            else:
                cur_v = [None,"UNK"]
                for tag1 in model[2].keys():
                    key1=str(token.word)+"|"+str(tag1)
                    key2 = str(vit_prev[1]) + "|" + str(tag1)
                    if model[1].has_key(key1):
                        w_t = (float(model[1][key1])/float(model[2][tag1]))
                    else:
                        w_t = 0.0
                    v = w_t*model[0][key2]*vit_prev[0]
                    v = [v,tag1]
                    if v[0] >cur_v[0] or cur_v[0] is None:
```

```
NavyaK:nlp Navya_Rachana$ time python POS_NAV/POS_TAG_Q1.py pos_tagger/data_public/hw3_train pos_tagger/data_public/hw3_heldout
Accuracy in training [35000 sentences]: 94.8186468586
Accuracy in training [13928 sentences]: 92.4838767831

real	0m14.666s
user	0m12.933s
sys	0m1.076s
NavyaK:nlp Navya_Rachana$
```

Accuracy in training [35000 sentences]: 94.8186468586
Accuracy in training [13928 sentences]: 92.4838767831

real 0m14.666s
user 0m12.933s
sys 0m1.076s

Question 3: HMM POS Tagging

Implementation:

Creating Model:

- The function initially calculates all the counts of words, tags, word|tag and tag|tag
- It then calculates the probabilities of word|tag and tag|tag
- The model then returns the probabilities and the tags count probabilities

Predicting test results:

- The Predict model calculates the Viterbi matrix in two ways: If the word is the start of the sentence it would calculate the from the Viterbi (<s>|<s>) which is taken as 1
- If the word is not the first word of the sentence it then calculates the Viterbi of the previous word|tags and finally get the result

Problems during Implementation

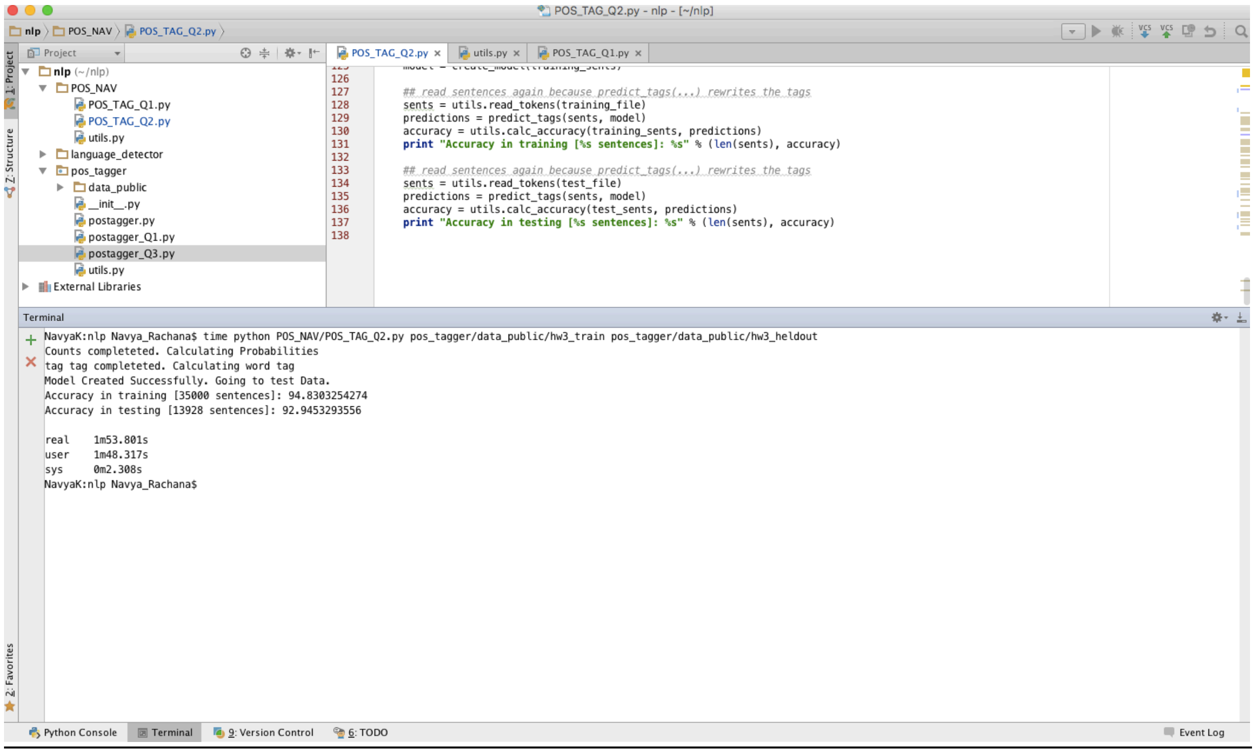
- Calculating the dictionaries for all the counts and probabilities
- Smoothing when probabilities aren't found
- Storing a dictionary of dictionaries in model
- Accessing the dictionaries passed in model from creating model function
- Logic for the Viterbi Calculation

Extra credit Unseen words:

For unseen words Regular Expression POS tagger from nltk is implemented with the following patterns.

```
patterns = [
     (r'.*ing$', 'VBG'),
     (r'.*ed$', 'VBD'),
     (r'.*es$', 'VBZ'),
     (r'.*ould$', 'MD'),
     (r'.*\'s$', 'NN$'),
     (r'.*s$', 'NNS'),
     (r'^-?[0-9]+(.[0-9]+)?$', 'CD'),  # cardinal num.
     (r'.*', 'NN')         # nouns (default)
]
```

Results: (LOWERCASING)



```python

    ## read sentences again because predict_tags(...) rewrites the tags
    sents = utils.read_tokens(training_file)
    predictions = predict_tags(sents, model)
    accuracy = utils.calc_accuracy(training_sents, predictions)
    print "Accuracy in training [%s sentences]: %s" % (len(sents), accuracy)

    ## read sentences again because predict_tags(...) rewrites the tags
    sents = utils.read_tokens(test_file)
    predictions = predict_tags(sents, model)
    accuracy = utils.calc_accuracy(test_sents, predictions)
    print "Accuracy in testing [%s sentences]: %s" % (len(sents), accuracy)

```

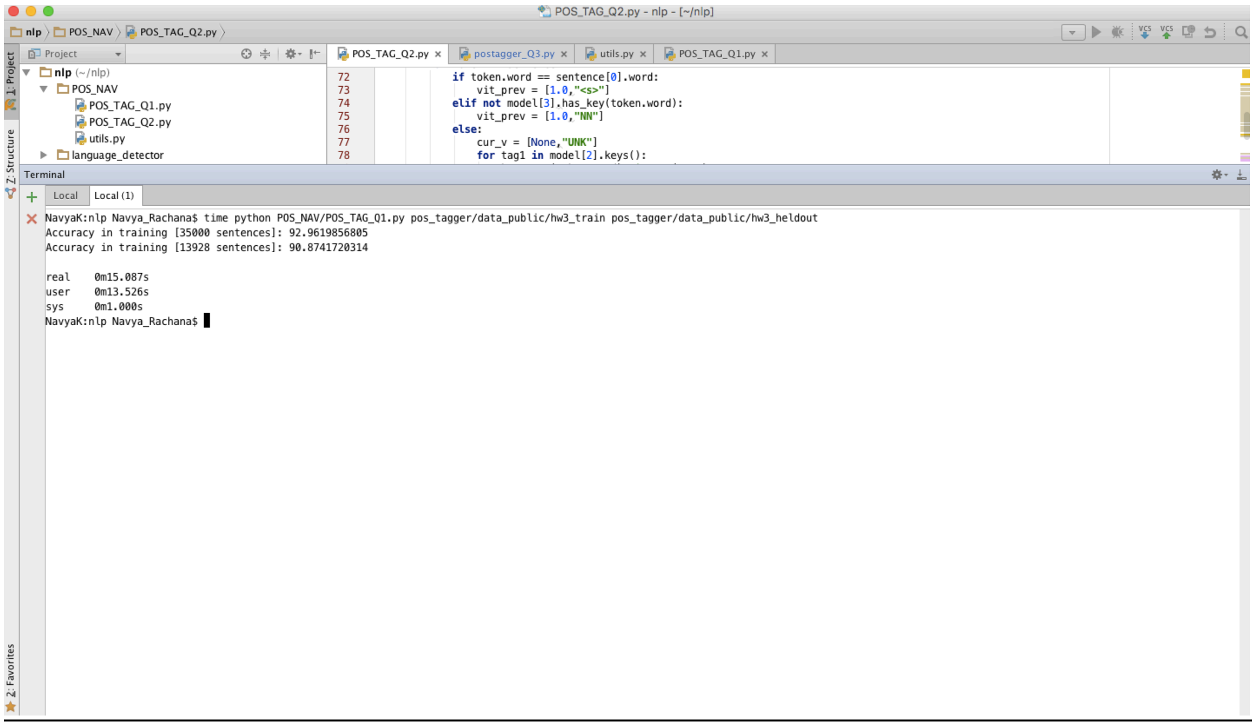
```
NavyaK:nlp Navya_Rachana$ time python POS_NAV/POS_TAG_Q2.py pos_tagger/data_public/hw3_train pos_tagger/data_public/hw3_heldout
Counts completeted. Calculating Probabilities
tag tag completeted. Calculating word tag
Model Created Successfully. Going to test Data.
Accuracy in training [35000 sentences]: 94.8303254274
Accuracy in testing [13928 sentences]: 92.9453293556

real    1m53.801s
user    1m48.317s
sys     0m2.308s
NavyaK:nlp Navya_Rachana$
```

Accuracy in training [35000 sentences]: 94.8303254274
Accuracy in testing [13928 sentences]: 92.9453293556

real 1m53.801s
user 1m48.317s
sys 0m2.308s

Results: (NO LOWERCASING)



```python
        if token.word == sentence[0].word:
            vit_prev = [1.0,"<s>"]
        elif not model[3].has_key(token.word):
            vit_prev = [1.0,"NN"]
        else:
            cur_v = [None,"UNK"]
            for tag1 in model[2].keys():
```

```
NavyaK:nlp Navya_Rachana$ time python POS_NAV/POS_TAG_Q1.py pos_tagger/data_public/hw3_train pos_tagger/data_public/hw3_heldout
Accuracy in training [35000 sentences]: 92.9619856805
Accuracy in training [13928 sentences]: 90.8741720314

real    0m15.087s
user    0m13.526s
sys     0m1.000s
NavyaK:nlp Navya_Rachana$
```

Accuracy in training [35000 sentences]: 96.3441454525
Accuracy in testing [13928 sentences]: 94.2741499328
real 1m33.712s
user 1m32.218s
sys 0m0.990s

Observation:

1. Lowercasing the words did not help in improving the performance in fact the performance decreased in both cases.